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PAPILLEDEMA WITHOUT INTRACRANIAL PRESSURE (OPTIC NEURITIS)

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ALTHOUGH papilledema is the most significant objective finding in brain tumors, it is by no means pathognomonic of this lesion. In 1937, the writer[1] reported a series of cases in which there was bilateral papilledema with intracranial pressure and yet no brain tumor. This condition, whatever the unknown cause or causes may be, could be safely differentiated from the tumor group by ventriculography. The ventricles were uniformly small, but showed no displacement. In the course of a most variable period of time, the intracranial pressure subsided and the patients remained permanently well. They were spared major operative procedures which would otherwise have been indicated, only a subtemporal decompression was necessary to preserve life and vision pending subsidence of the intracranial pressure.

The present report is concerned with another, even larger, group of cases having papilledema, usually bilateral, at times unilateral, frequently with hemorrhages in the eyegrounds, and usually with a mild degree of headache and with varying degrees of visual loss. This group differs from the foregoing one in the absence of intracranial pressure. The underlying pathologic process causing the papilledema, whatever its character or the underlying cause, is, therefore, largely of *local* origin and may be classified as "optic neuritis," "papillitis," or "retrobulbar neuritis," if it is understood that these designations do not connote an inflammatory process, which it may or may not be. There can be little doubt that the pathologic process is, in many instances at least, not strictly confined to the optic nerve or nerves because of the frequent coexistence of other signs and symptoms, such as headaches, diplopia, dizziness and perhaps nausea and vomiting. But the intracranial involvement beyond the optic nerves is rarely great or severe. There can also, I think, be no doubt that this is not strictly a pathologic or clinical entity, for in a few cases at least, the ophthalmologic picture is an initial manifestation of multiple sclerosis, and in one patient who died 14 months later the microscopic sections of the brain showed diffuse chronic encephalitis involving the cerebral cortex. However, the number of such cases, studied over such a long period of time, is so small that one can be

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equally certain that multiple sclerosis or encephalitis is the exception rather than the rule. From the evidence at hand it is not possible to say that the pathologic process is one of demyelinization in the optic nerves, or an inflammatory or perhaps some other process.

On the whole, the pathologic process and its signs and symptoms are acute or relatively so; it subsides spontaneously with or without a permanent visual defect and has almost no tendency to recur (a single exception). In most of these cases the differential diagnosis from a brain tumor has been made by ventriculography, and the absence of intracranial pressure has been determined by manometric readings of the spinal fluid by spinal puncture. In some of the later cases the clinical picture has seemed adequate to make the diagnosis without either ventriculography or spinal puncture. The principal differential diagnostic test of this condition is a rather precipitate loss of vision—much too rapid to be possible from the effects of intracranial pressure. One also considers, though with less assurance, the relatively slight headache accompanying such a high grade of papilledema with retinal hemorrhages.

Since there is no intracranial pressure, operations upon the brain are not indicated. It is cases of this kind that have been subjected to exploratory craniotomies with negative findings, to decompressions and to operations upon the paranasal sinuses. The latter operations have been performed on the assumption that an inflammatory process has extended through the bone of the skull and into the optic nerves. And many teeth have been pulled in the search for an inflammatory focus.

Since the pathologic process is one of relatively short duration and clears spontaneously, it is not surprising that excellent results have been claimed following any therapeutic efforts, whether surgical or medical, but the results are, of course, *post hoc, propter hoc.*

Forty-four cases of this condition are included in this report, and the end-results presented in 31. From the remaining 13, no answer has been received to inquiries by letter. The cases are spread over the past 15 years. The results of the study are presented in the accompanying table and are summarized in the ensuing résumé.

Sex and Age Incidence.—Curiously enough, females are almost three times as frequently affected as are males—the exact number of each being 32 and 12. Such a great difference in the sexes must carry some significance but I know of no explanation.

This condition occurs in every decade of life up to the seventieth year, and with surprising regularity except in the second decade where the number was more than double. The actual numbers by decades were 6, 15, 6, 6, 7 and 4.

Résumé of Signs and Symptoms: Duration.—To the time of admission to the hospital, the condition has existed less than one month in 21, or nearly half of the cases; less than three months in 31, 70 per cent of the

cases. It was less than six months in 38 cases, or 86 per cent; less than one year in the remaining six. In one case, under observation almost from the beginning of the illness, the patient was practically blind within five days; three days later the visual fields and visual acuity were normal, and one year later the vision was still perfect. There can be no doubt that many patients who appear months or years after an initial attack of visual loss have had edema at the onset, and at this late date there remains only some evidence of pallor in the optic disks.

Headache.—In 37 cases from the series, headache was a conspicuous symptom; in five it was absent, and in two not mentioned. In most instances the headache appeared almost simultaneously with loss of vision. It was never as severe as in brain tumors, although instances of the latter without headache are by no means uncommon. At times the headache was bilateral, and at other times unilateral. Often it was in the frontal region, or behind the eye, and not infrequently more of a stinging, boring pain rather than an ache.

As noted above, the relatively slight degree of headache was in such marked contrast to the severe grade of papilledema that the diagnosis of an intracranial neoplasm was considered unlikely.

Diplopia, Nausea, Vomiting, Dizziness and Convulsions.—Double vision was present in 13 cases and absent in 25, *i.e.*, it was present in roughly one-third of the cases. Only in three cases was there an extra-ocular palsy and in one of these it was bilateral. One of the unilateral palsies was the case of encephalitis; the bilateral palsy was in a particularly severe illness with total blindness which has persisted though the patient is otherwise well, 11 years later; the third case has not responded to our letter of inquiry. The appearance of diplopia means, of course, that the pathologic process has extended beyond the optic nerves. Except in the cases where an extra-ocular palsy has followed, the diplopia has always been of short duration—in one instance only 30 minutes.

In nine cases there was nausea, and in 12 vomiting, but in two of the latter it was said to have followed medicine by mouth. In no instance was either the nausea or vomiting prolonged or severe, and in many vomiting occurred only once.

Dizziness occurred in ten cases and was never severe.

Convulsions were present in none. This negative note is recorded because it is fairly important evidence against any degree of cerebral involvement.

Other Signs and Symptoms.—One patient had numbness of the face; she has since been followed (two and three-fourths years) and has had no return of it. Another had weakness of the right arm, polydipsia and palsy of the right sixth nerve; her subsequent course is unknown; it may be a case of multiple sclerosis. Another patient subsequently developed characteristic signs and symptoms of multiple sclerosis, *i.e.*, ataxia, Romberg, staggering gait and urinary incontinence. A bilateral Babinski sign was elicited in one

patient; it has since disappeared and she remains perfectly well. Bilateral ataxia was noted in another patient, who probably had an acute encephalitis following pneumonia (Streptococcus); except for a severe loss of vision she recovered completely. Buzzing in one ear was noted by one patient whose subsequent course is not known, and by another who recovered with total blindness but with no return of the buzzing; bilateral exophthalmos of low grade developed during the present illness and subsequently disappeared.

In three patients adiposity was excessive. In two, the menses had disappeared, and in the third, they subsequently disappeared but returned following injections of hypophyseal extract. In each of the above three adipose individuals the increased weight had long antedated (one, three and 12 years) the visual disturbance and could, therefore, have had no bearing upon it. Since this abnormal grade of adiposity is so commonly associated with menstrual irregularity and loss, it is probable that this disturbed function was also not related to the papilledema. However, in one patient the amenorrhea developed only one month before her visual loss and she dated the present illness from it.

Polydipsia was a symptom in one case and was perhaps a manifestation of encephalitis.

Three patients in this series had hypertension—two of moderate (170, 168) and one of severe grade (220). The frequent association of papilledema with hypertension of severe grade is well known. I have excluded from this series those cases in which the papilledema appeared to be directly related to the hypertension. In the three cases included in this report, there can scarcely be a doubt that the hypertension was entirely independent and unrelated. One patient with a blood pressure of 178 died eight years later following an abdominal operation, the findings of which are unknown. Her vision had remained unchanged in the interim. The most surprising case was that of a colored woman, age 44, blood pressure 220/110. Following an acute visual disturbance, with 4 D. of papilledema and hemorrhages in both eyegrounds, the patient's vision returned almost to normal and has remained so for six and one-half years, and despite continuous hard work she is symptomless and her blood pressure remains 220/110. Her blood pressure surely has nothing to do with her acute visual episode. The third patient, whose pressure was 180, cannot be traced.

In only a single patient was there a positive Wassermann reaction; this was positive both in the blood and spinal fluid. Whether or not it was related to the papilledema cannot be determined. The eyegrounds rapidly became normal during vigorous antisyphilitic treatment. The story is so similar to that of so many other cases—all without syphilis—that I doubt the relationship.

Etiology.—That this series of cases contains not a single pathologic entity is shown by the fact that there is certainly one and probably a second case of multiple sclerosis, and one and perhaps two more cases of encephalitis.

Name and Date	Age	Sex	First Symptom	Duration	Vision	Scotomata and Blind Spots	Visual Fields	Visual Acuity	Papilledema	Hemorrhage in Eyegrounds	Diplopia	Headache	Nausea	Vomiting	Dizziness	Convulsions	Other Symptoms	O
No. 1—R. F. U-63703 7/16/35	19	M.	Loss of vision	2 mos.	Loss in right temporal field; subjective and objective	Huge blind spot right eye	Temporal constriction for colors on right	20/15 each eye	1 D. right, haziness left	One large hemorrhage on right	o	+ 5 days, occipital	o	o	o	o		
No. 2—R. H. U-63609 7/11/35	19	F.	Headache in attacks 3 to 4 hrs.	1 mo.	Blurring	Normal	Normal	20/15 left, 20/100 right	2 D. bilateral	o	+	Right temporal		+	+ Twice		Numbness right side of face	
No. 3—K. L. U-13431 7/29/27	16	F.	Headaches; blurring vision	5 wks.	Blurring	Normal	Normal	20/20 bilateral	1 D. bilateral	o	o	+ Frontal	o	o		o		8 w lb ga
No. 4—L. L. U-10646 7/22/27	8	M.	Headache	Few mos.	Blurring		Normal	20/20 bilateral	3 D. left, blurring right	o	o	+ Frontal	o	o	o	o		
No. 5—K. S. U-23536 3/7/39	6	F.	Blindness (over 1 wk.)	1 wk.	Blind		Suggestive left homonymous hemianopsia	Can see fingers at 2 ft.	6 D. bilateral	o	o	+ Frontal	o	o	o	o		B n
No. 6—M. T. U-162163/4 1/11/28	25	F.	Loss of vision	2 mos.	Nearly blind	Big paracentral scotoma each side, left twice right	Large nasal constriction, left; some right	Left, only fingers; right much better but greatly affected	5 D. bilateral	+ Bilateral, minute and large	+	Pain in neck and occipital	o	o	Slight	o	Noise in left ear	B r p h er
No. 7—D. P. U-62259 5/7/35	47	F.	Pain over both eyes. Dimness of vision	1 wk.	Blurred	Big paracentral scotoma, right; one week later this was much smaller, but a similar one appeared on left	Normal	20/50 right, 20/70 left; 1 wk. later 20/50 right, 20/100 left	2 D. bilateral	o	+	+	o	Only after medicine	o	o		
No. 8—L. J. U-69846 7/29/36	43	F.	Pain left eye; dimness of vision	10 days	Blurred	Normal	Marked constriction of fields	12/200 right, 3/200 left	3 D. bilateral	Many in both eyegrounds		+ Pain left eye; 5 days later in right. Frontal headaches	o	One spell	o	o		
No. 9—A. J. U-68061 2/26/36	39	F.	Dimness of vision	12 days	Blurred	Enlarged blind spots; temporal scotoma, bilateral	Negative but difficult to chart because of very poor vision	5/200 right, 5/100 left	1¾ D. bilateral	o	o	+ Frontal worse	+	+	o	o		
No. 10—C. V. U-130313 2/1/38	24	F.	Acute illness with coma, 4 days	5½ mos.	Diminished for 1 mo., stationary since; now 20/70 bilateral	Now small scotoma each side, below fixation point	Marked general constriction	Light perception only, end of 1 mo; improvement thereafter	4 D. bilateral 1 mo. after P.I. began; since disappeared	o	o	+ Severe at first	o	++	o	o	Bilateral ataxia (since disappeared)	
No. 11—H. S. U-130146 1/15/38	10	M.	Headache; dimness of vision	1 wk.	Light perception right; 20/100 left	Large scotoma left, central and paracentral	Left normal; right gone	20/100 left; light only right	2 D. bilateral	o	o	+ Right frontal	o	o			Chills and fever for 3 days, one month before vision lost	
No. 12—V. M. U-14696 10/10/27	27	F.	Dimness of vision	Few mos.	Dimness	Normal	Normal	20/15 bilateral	1 D. bilateral	o	o	+ Right frontal and spreads, possibly neurogenic	o	o	o	o		
No. 13—C. R. U-44742 8/5/32	47	F.	Haziness of vision	8 mos.	Dimness	Paracentral scotoma left; somewhat large blind spot, right	Concentric contraction both eyes, more left	20/40 right, 20/100 left	2 D. right; 1 D. left	o	o	+ Left occipital and spreads	o	o	o	o		
No. 14—A. T. U-60104 6/29/23	19	F.	Eyes tired	6 mos.	Blurring	Normal	Normal	Normal	2 D. bilateral	o	+	o	o	o	+	o	Sudden weakness left hand; right leg dragged and numb	Rom stagg nyst
No. 15—C. W. U-40770 12/18/31	45	M.	Blurring of right eye; left, 2 days later	1 wk.	Nearly blind	Could not be tested because fields nearly gone	Reduced; small segment in each eye; left field larger	20/50 right, 10/200 left; no color perception	2 D. left; 1 D. right	+ Tiny hemorrhages, bilateral	+	Back of head; dull	+	o				Recu tack
No. 16—M. M. U-37462 6/4/31	40	F.	Headaches	8 mos.	Recurring blind spells; dimness of vision, more left	Both enlarged	Normal	Normal	Bilateral but more left	+	o	+	o	o	o	o	None	Obes metal —22
No. 17—W. H. U-74082 11/7/36	8	M.	Getting "dumb"	6 mos.	Failed rapidly	Could not be tested	Could not be tested	Could not be tested	2 D. bilateral	o	+	+ Frontal, bilateral	?	+ Projectile		o	Poor concentration, reading worse; unsteady gait; right facial weakness; salivation; drowsy	Left p a l s sphinc trol fr
No. 18—E. W. U-41288 1/19/32	28	F.	Blurring vision; sudden severe headache; diplopia	1 mo.	Blurring	Enlarged on both sides	Normal	70/100 right, 20/70 left	2 D. bilateral	One in left eyeground	+ Transient attacks		+	+	+ Few spells	o	Menses about 1 yr., gained 60 lbs. in 1 yr.	No ca amenc
No. 19—E. Z. U-73778 10/14/36	12	F.	Headaches and poor vision	1 yr.	Says it is poor but is perfectly normal		Normal	20/20 in each eye	4 D. each eye	o	+	+	+	+	+	o	None	
No. 20—T. N. U-73865 10/5/36	14	M.	Headaches and double vision	1 mo.	Normal	Normal	Normal	20/20 in each eye	2 D. each eye	+ On both sides	+ For 10 days	+ Severe for 2 wks.		+		o	None	
No. 21—J. M. U-50129 11/16/34	11	F.	Blind spells	2 wks.	Dimness	Twice normal size	Normal, except colors reduced	20/50 right, 20/40 left	3 D. each eye	+ Many on both sides	o	None	o	Only after puncture	o	o	Buzz in right ear on two or three occasions	
No. 22—C. P. U-13302 7/21/27	10	F.	Headaches	2 mos.	Normal		Normal	20/20 each eye	3 D. each eye	o	o	+					None	
No. 23—K. S. U-30178 9/16/31	10	F.	Headaches	1 yr.	Normal		Normal	Normal	2 D. each eye	o	+ Four wks.	+	o	o	+ 3 attacks	o	None	
No. 24—L. S. U-32262 7/27/30	8½	M.	Vomiting; eyes hurt; poor vision	16 days	Can not see clearly		Probably restricted	20/200 each eye; 1 mo. later 20/30; 5 mos. later 20/20	4 D. right, 3 D. left; disappeared in 1 mo.	+ Bilateral	o	+ Not severe			+	o	Little drowsy; listless, does not play	Temp slight VI

TABLE I

LOGY AND OBJECTIVE FINDINGS IN FORTY-FOUR CASES OF PAPILLEDEMA WITHOUT INTRACRANIAL PRESSURE

ul-s	Other Symptoms	Other Objective Findings	X-rays	Ventriculography	Cerebrospinal Fluid			Spinal Wassermann	Blood Wassermann	Nasal Sinus Examination	B. P.	Treatment	Time Elapsed	Result	Final Diagnosis	Remarks
					Pressure	Cells	Protein									
			Negative	Negative	120 Mm. spinal	9; 3 days after ventricular puncture		Negative	Negative		120/70	None	2¾ yrs.	Eyesight unchanged. Large scotoma and primary atrophy right eye, left normal; acuity 20/15 each eye		
	Numbness right side of face		Negative	Negative	120 Mm. spinal			Negative	Negative	Negative	108/78	None	2¾ yrs.	Headaches disappeared, disk papilledema; vision normal		
		80 lbs. overweight (184 lbs.), gradual gain for 12 yrs.	Negative	Negative	Negative ventricular	0	0	Negative	Negative	Negative	124/60	None	11 yrs.	Vision perfectly normal		Patient now weighs 250 lbs.; menses gradually disappeared, but returned with endocrine injections. Adiposity antedated the papilledema
			Negative	Negative					Negative	Negative		None	11 yrs.	Normal in every way		
		Bilateral blindness	Negative	Not done					Negative	Negative		None				
	Noise in left ear	Both external recti became palsied while in hospital. Bilateral exophthalmos	Negative	Negative	Normal ventricular	6	Negative	Negative	Negative	Negative, both sphenoids and ethmoids opened	130/90	Sinuses opened; also craniotomy to explore optic nerves, all negative	9 yrs.	Well 9 yrs. later, except for defective vision. Can read only large type. Has taken up Braille		
			Negative	Negative	Normal ventricular		0	Negative	Negative	Negative; teeth negative	115/75	None	3 yrs.	Vision normal		
			Negative	Negative	Normal ventricular; spinal 170 Mm.	8	0	Negative	Negative		158/95	None	3 yrs.	Vision 20/30 each eye		
			Negative	Negative	Normal spinal and ventricular		0	Negative	Negative	Negative	150/90	Tuberculin injections				
	Bilateral ataxia (since disappeared)		Negative	Negative; done at time of maximum signs and symptoms		6		Negative	Negative	Negative	114/68, has been 150	None	6 mos.	Well, but vision defective, same as when in hospital here	Probably acute encephalitis. Doctor Ford thinks multiple sclerosis	Present illness began very acutely 3 wks. after recovery from pneumonia (Streptococcus and influenza); confused, vomited, semiconscious 4 days; said to have had right facial weakness and ataxia, severe right-sided headaches, much vomiting; no fever. Ventriculography done elsewhere at height of illness (1 mo. later) was negative. It looks as though the illness (acute) has run its course and left severe visual loss
	Chills and fever for 3 days, one month before vision lost		Negative	Negative	170 Mm.	8	0	Negative	Negative	Negative	100/74	None				Says vision lost immediately after trivial accident
			Negative	Negative							110/75	None	10¾ yrs.	Has been perfectly well		
			Negative	Negative	Normal ventricular			Negative	Negative	Negative	136/76	None	5¾ yrs.	Eyes have remained unchanged; general health good; nervous		
	Sudden weakness left hand; right leg dragged and numb	Romberg and staggering gait; nystagmus	Negative	Not done	Normal			Negative	Negative		106/70	Cerebellar exploration; no pressure	14½ yrs.	Now quite feeble; eyesight still preserved	Multiple sclerosis	This patient has steadily gone downhill with numerous exacerbations of motor and sensory loss; unable to walk for 5 or 6 yrs.
		Recurrent attack 3 yrs. later	Negative	Negative	Fluid spurted			Negative	Negative		110/70		6 yrs.	Patient has good vision; reads newspapers without trouble. Eyegrounds show nothing abnormal; fields normal on rough test. Well except for attacks of numbness in fingers, but only when recumbent. Disks normal; little pale; acuity 20/20; fields normal. (3/1/38)		One mo. later, had left homonymous hemianopsia with hazy vision in the defective fields; acuity then 20/15 each eye; big blind spot left. Colors in good fields are normal. In 6 mos. fields improved, especially colors. Patient says vision good as ever; 3 yrs. later, sudden loss of vision again right eye, no papilledema but acuity 1/200; two large temporal scotomata left, and a huge one right central. In 1 mo. vision again almost normal. In 7 mos. acuity 20/20 right, and 20/20 left
	None	Obese, basal metabolic rate −22	Negative	Negative small ventricles	Negative	4	25 mg. %	Negative	Negative	Negative	114/70	None	6¾ yrs.	Papilledema subsided during stay in the hospital; vision 20/20— in each eye. 3/1/38: Vision given 20/15 right and 20/20 left; disks clear		Patient had headaches all her life but became intensified 8 mos. ago. Blind spells in left eye 4 to 5 per day, lasting few seconds
	Poor concentration, reading worse; unsteady gait; right facial weakness; salivation; drowsy	Left abducens palsy; loss sphincter control frequently	Negative	Negative small ventricles	250 Mm. on one occasion	0	50 mg. %	Negative	Negative	Negative	95/50	None	14 mos.	Died 14 mos. later. Brain examined; looked normal in the gross but sections showed diffuse encephalitis throughout the cerebral cortex		Was kept in hospital 4 mos. Mentality steadily worse. Diagnosis of multiple sclerosis was made tentatively, but there was so much mental change it was probably encephalitis
	Menses about 1 yr., gained 60 lbs. in 1 yr.	No cause for amenorrhea	Negative	Negative	Normal	6	25 mg. %	Negative	Negative	Negative	120/80	None				
	None		Negative	Small normal	80 Mm.	0		Negative	Negative		100/70	None				
	None		Negative	Small normal	No pressure from ventricules. 170 Mm. by lumbar puncture	0	25 mg. %		Negative		124/80	None				Headaches lasted only 2 wks.
	Buzz in right ear on two or three occasions		Negative	Normal	Normal	2	Negative	Negative	Negative		110/70	None	3 yrs.	14 mos. later, vision 20/20 left, and 20/30+ right; papilledema gone. 3 yrs. later, perfectly well		Headaches appeared only after lumbar puncture. None before despite high papilledema and reading of 600 Mm. of lumbar fluid (done elsewhere)
	None		Negative	Normal	Normal						108/76	None				Bilateral mastoid with draining ears and pneumonia immediately preceding development of papilledema which was found accidentally. Abscess of brain suspected
	None		Negative	Normal	+ (?)		25 mg. %	Negative	Negative		98/60	None		6¼ yrs. later, perfectly normal in every way		
	Little drowsy; listless, does not play	Temp. 99.8° F., slight bilateral VI	Negative	Normal	None by ventricular puncture	12 monos.	0	Negative	Negative	Negative	100/56	None				

No. 22—C. P. U-13302 7/22/27	10						Normal	20/20 each eye	3 D. each eye	o	o	+					None
No. 23—K. S. U-39178 9/16/31	10	F.	Headaches	1 yr.	Normal		Normal	Normal	2 D. each eye	o	+ Four wks.	+	o	o	+ 3 attacks	o	None
No. 24—L. S. U-32262 7/27/30	8½	M.	Vomiting; eyes hurt; poor vision	16 days	Can not see clearly		Probably restricted	20/200 each eye; 1 mo. later 20/30; 5 mos. later 20/20	4 D. right, 3 D. left; disappeared in 1 mo.	+ Bilateral	o	+ Not severe			+	o	Little drowsy, listless, does not play
No. 25—M. S. U-37437 6/2/31	30	F.	White spots before eyes; transient blind spells	6 mos.	Dimness; blurring	Slightly large	Some restriction nasal field left eye—color and form	20/15 right, 20/40 left	2 D. right, 3 D. left	+ Bilateral	o	Slight	o	o	o	o	
No. 26—H. R. U-32029 7/7/30	22	F.	Throbbing frontal and eyeball; blurring vision	3 mos.	Blurring	Slightly large	Normal	20/200 left, right congenitally defective	3 D. left	+ Many small	o Only one good eye	Throbbing pain forehead and left eye	+ Once	+ Once	o	o	Left eye [illegible] lid swollen; lacrymation [illegible] burning
No. 27—E. A. U-60066 1/10/35	7	M.	Headache	6 wks.	Normal	Left slightly larger	Some general contraction left field	Normal 20/15 each side	2 D. left; None right	o	+ After lumbar puncture	Right side, not severe	o	o	o	o	
No. 28—H. B. U-41030 1/5/32	40	F.	Headache	2 yrs.	Blurring 6 wks.	Slightly large	Normal	20/70 each side	Blurring of disks	o	o	Occipital +	+	+	o	o	Stinging [illegible] photophobia
No. 29—T. B. U-31000 5/8/30	14	F.	Double vision, 1 wk. after a head cold	5 wks.	Blurring in spells	3 times normal; both alike	Left nasal field constricted	20/100 right, 10/100 left	5 D. each side	+ Bilateral	+ First complaint persists	+ Spells of 4 to 5 mins. for over 1 yr.	o	o	+	o	Weakness [illegible] arm, lasting [illegible] polydipsia
No. 30—M. B. U-68817 4/28/36	36	F.	Headache, nausea, soreness in eyes	1 mo.	Blurring vision, 2 days after first symptom; almost blind	Central scotoma right; only light perception left	Loss of all color	10/200 right; left has only light perception	4 D. each side	+ Bilateral	o	+	o	o	o	o	
No. 31—M. C. U-58953 11/9/34	30	F.	Amenorrhea, nausea	5 mos.	Blind spells 4 mos.	Double, normal both sides	Normal	20/20 each side	3 D. each side	o	o	o	+ Once	+	o	o	Menses a[illegible] 3 mos.; gain[illegible] lbs. in 5 [illegible]
No. 32—H. D. U-59814 12/26/34	27	F.	Headaches	2 mos.	Blurring at times	Slightly large	Normal	20/20 each side	1 D. each side	o	o	o	o	o	o	o	
No. 33—M. J. U-27386 10/22/29	53	F.	Failing vision	3½ mos.	Greatly reduced	Large scotoma left temporal field	Partial hemianopsia to left (homonymous) both color and form	5/40 right, 15/20 left ¼–1 D. swelling	Haziness of borders		o	o Occasionally soreness of eyeballs	o	o	o	o	None
No. 34—J. M. U-13599 8/9/27	56	M.	Failing vision	1 yr.	Greatly reduced right; left normal	Paracentral scotoma right	Both normal	6/70 right, 20/20 left	2 D. right, left normal	Many in right; none left	+ 8 mos. ago	+ For 4 yrs. constant	o	o	o	o	
No. 35—J. P. U-11603 4/19/27	10	M.	Eyes burn, dimness of vision	4 mos. 2 wks.	Very poor	Large central scotoma, both sides	Left lower field gone; no colors	Bilateral 2/100	2 D. bilateral	Many both sides	o	Frontal pain	o	o	o	o	Eyeball red[illegible] ery morning[illegible] 2 mos. b[illegible] loss of visio[illegible]
No. 36—A. M. U-44748 8/8/32	16	M.	Loss of vision	3 wks.	Right poor; left normal	Large blind spots at right	Nasal field right almost gone; left normal	Fingers only right; 20/15 left	2 D. right, left normal	Many minute hemorrhages on right	o	Pain in eye	o	o	+	o	Tender, sw[illegible] upper right[illegible] 3 days befor[illegible] set of preser[illegible] ness
No. 37—F. F. U-13708 8/22/27	36	F.	Blurred vision	2 mos.	Greatly reduced	Both enlarged equally; paracentral scotoma right	Normal	20/30 bilateral	4 D. bilateral	Many both sides	o	+ Generallzed	o	+ After medicine	o	o	
No. 38—J. H. U-67457 1/26/36	64	M.	Dimness of vision	3 wks.	Rapid contraction of visual fields	Only central vision remains	Rapid contraction	20/15 left (right eye removed glaucoma)	3 D. left (right removed)	+ Left (right removed)	Has only one eye	+ Slight	o	o	o	o	Right eye [illegible] moved for gl[illegible] coma 1 yr. ag[illegible]
No. 39—M. M. U-13737 8/18/27	50	F.	Loss of vision	1 wk.	Blurring right eye, now blind	Enlarged left, blind right	Blind right, left normal	Blind right, normal left	1 D. left, atrophy right	o	o	+ Over right eye	+		o	o	None
No. 40—R. R. U-72785 11/9/36	8	M.	Pain frontal; loss of vision 2 days later	5 wks.	Practically blind in 5 days	Nearly blind	Had little to chart	Count fingers with right eye, left nil	1 D. bilateral	o	o	Frontal	o	o	o	o	None
No. 41—D. B. U-38045 5/5/32	10	F.	Pain right eye and forehead; dimness of vision right eye	1 wk.	Practically blind right eye	Very large central scotoma right, none left	Peripheral field fairly normal; on right scotoma covers one-half of field	1/200 left, 20/15 right	4 D. right, 0 left	o	o	Frontal	o	o	o	o	None
No. 42—L. W. U-100223 3/4/37	12	F.	Headache; dimness of vision	1 wk.	Blurring	Central scotoma both sides	Great reduction of peripheral fields, more left	20/50 right, 20/70 left	2 D. bilateral	o	+ For 30 min.	Frontal	+	o	o	o	None
No. 43—R. C. U-40047 12/13/31	44	F.	Sudden loss of vision in left eye	3 wks.	Left poor	Both double	Normal	12/200 left, 20/20 right	4 D. bilateral	+ Bilateral	o	+ "Gnawing" pain in occiput	o	o	+	o	None
No. 44—R. MacL. U-73036 10/26/36	36	F.	Dimness of vision	2 mos.	Blurred	None	Normal	20/40 each eye	2 D. bilateral	o	o	o	o	o	o	o	None

			Normal	+ (?)		25 mg. %	Negative	Negative		98/60	None		6½ yrs. later, perfectly normal in every way
Little drowsy; listless, does not play	Temp. 99.8° F., slight bilateral VI	Negative	Normal	None by ventricular puncture	12 monos.	0	Negative	Negative	Negative	100/56	None		
		Negative	Normal	None by ventricle; said to have been 500 Mm. by lumbar puncture 1 wk. ago (done elsewhere)	3	25 mg. %, + on earlier examination elsewhere	Negative	Negative	Negative	140/90	None	6½ yrs.	Perfectly well; vision normal
Left eye injected; lid swollen; lacrymation at beginning	Congenitally defective right eye	Negative	Normal	Normal ventricular		0	Negative	Negative		140/105	None		
		Negative	Normal	Normal, ventricular	2	25 mg. %	Negative	Negative		120/90	None	3¼ yrs.	Perfectly well but defect in left temporal field persists. Acuity 20/20 each eye
Stinging eyes; photophobia	Hypertension	Negative	Negative, quite small	Normal, ventricular	6	25 mg. %	Negative	Negative		180/90			
Weakness right arm, lasted 1 wk.; polydipsia	Palsy Right VI	Negative	Normal	Normal, ventricular	2	+	Negative	Negative	Negative	140/65	Tonsils removed; tuberculin treatment		
	Positive Wassermann	Negative	Normal	Normal, ventricular	2	25 mg. %	+	+		120/80	Antisyphilitic, intensive	2 yrs.	5 mos. later could see as well as ever. 3/1/38: Vision normal
Menses absent 3 mos.; gained 70 lbs. in 5 yrs.		Negative	Normal, very small	Normal, ventricular	4	25 mg. %	Negative	Negative		118/74		3½ yrs.	Perfectly well; eyesight normal. No headache
		Negative	Normal, very small	Normal, ventricular		Negative	Negative			96/60		12 yrs.	Well; eyesight normal. Headaches have disappeared
None	None	Negative	Not done					Negative	Negative	140/86	None		
	Deaf right ear, since childhood	Negative	Large ventricles but symmetrical	None at operation				Negative	Negative	132/80	Cerebellar exploration; negative findings	3 yrs.	Died 3 yrs. later. Cause not known
Eyeball red every morning, for 2 mos. before loss of vision		Negative	Negative	Normal, ventricular				Negative	Negative test; ethmoids opened; no pus	90/45	None	11 yrs.	Eyesight normal
Tender, swollen upper right lid, 3 days before onset of present illness		Negative	Negative	Spinal pressure 130 Mm.	4		Negative	Negative	Negative	120/70	None	5½ yrs.	Right disk is big scar (vessels cannot be seen; disk margins sharp); choroidal patch upper temporal. Nasal field defect persists
		Negative	Rather large ventricles but no obstruction	310 Mm. done elsewhere	2	0	Negative	Negative	Negative	136/72	Cerebellar; negative findings	10½ yrs.	Perfectly well
Right eye removed for glaucoma 1 yr. ago	Negative	Negative	Not done	Not tested	Not exam.			Negative	Negative	140/90	None	2 yrs.	Vision remains unchanged; acuity 20/15; only central vision
None	B.P. 178/110	Negative	Not done	Not tested	Not exam.			Negative	Negative	178/110	None	Died 8 yrs. later	Local condition remained unchanged
None	None	Negative	Negative	Normal	Not exam.			Negative	Negative		None	12 yrs.	Normal vision left; only useful vision right
None		Negative	Not done	Not tested	Not exam.			Negative	Negative	100/60	None	6 yrs.	Vision unchanged
None		Negative	Not done	Not tested	Not exam.			Negative	Negative	112/40	None	1 yr.	Vision normal; well in every way
None	B.P. 220/110	Negative	Normal	Spinal slightly increased, not measured	10	0	Negative	Negative	Negative	220/110	None	6½ yrs.	Patient well in every way; no headaches. B.P. still 220/115. Visual acuity 20/20 right; 20/70 left; fairly normal fields in both eyes
None		Negative	Normal	280 Mm.	Not exam.			Negative	Negative	130/80	None	1½ yrs.	Vision essentially the same; otherwise normal

	Trauma to head 6 wks. before onset of present illness
	5¼ yrs. later B.P. 195/110, eyeground normal, vision same. Gallstones removed 10/27/36—2¾ yrs. after
	1 mo. later vision 20/30 right and 20/40 left, and blind spots normal
	Initial symptoms thought, to be cold—nose runs but throat not sore. In 1 wk., headache much worse and was color blind. After another week improvement began. Return of symptoms after 3 wks. Taking antisyphilitic treatment
	Later, there were some headaches but not severe. 3 mos. later vision much worse
	Headaches preceded dimness of vision by 3 yrs., and probably not related to ocular condition
	1 mo. later, vision normal in every way; vision 20/20; fields and color vision perfect; no scotoma
	It is interesting and doubtless significant that the inflammatory process in the right eye preceded visual loss and papilledema is on same side and only this side
	At cerebellar operation, no pressure after cisterna magna evacuated. Vision normal month later; scotoma gone
	Patient died 8 yrs. later of another cause. Had an abdominal operation
	1 yr. before present illness, patient had an attack of acute encephalomyelitis with marked sensory and motor loss from spinal involvement. Subtotal recovery. 5 yrs. later operation for hallux valgus. No further symptoms referable to the brain or cord
	5 days after report given in table, vision had almost cleared. There still remained some peripheral restriction on left but right normal for form and color, and acuity 20/30 each eye. In another 3 days, both fields were normal. 1 yr. later she was well and at school—vision normal

The association of papilledema with both of these lesions is well known. But I do not believe any of the remaining cases could fall under either multiple sclerosis or encephalitis.

A nonspecific inflammatory origin is suggested in three cases. In one instance there was tenderness and swelling of one eyelid at the onset of symptoms, and the papilledema developed only in the corresponding eyeground which contained numerous small hemorrhages. Five and one-half years later the center of the disk was filled with a scar that entirely concealed the entering blood vessels; the visual acuity was 20/20 in each eye but a temporal defect remained in the affected eye. In another case, the left eyelid was swollen and painful and there was lacrimation at the time of onset of the visual change. The other eye had been blind from birth. She had had unilateral retinal hemorrhages, but her subsequent course is not known. The third patient had redness of the eyeball for two months before vision was affected. Although the eyesight was badly affected and there were numerous hemorrhages in the eyegrounds, he reports normal vision 11 years later.

A fourth patient had just returned from a ride on horseback, three weeks after recovery from pneumonia (Streptococcus and influenza organisms were grown from cultures), when she suddenly became confused, semicomatose and delirious. She is said to have had fever, vomiting, ataxia of both hands, in addition to papilledema and loss of vision. There must have been a very diffuse encephalopathy, and occurring so soon after the attack of pneumonia it would appear probable that this was the same source of the inflammatory process in the brain—though without pus formation.

A fifth patient had stinging eyes and photophobia—both suggestive, but not indicative of mild inflammatory origin.

It is worthy of note and perhaps significant that cases with the probable evidence of slight inflammatory character have all been severe, in that they have had hemorrhages and visual defects. However, if these findings are evidences of inflammatory origin, none of them have been pyogenic and none have shown alterations of the cerebrospinal fluid. In none of the remaining cases—excepting the single case of syphilis—has there been any evidence to suggest that the process may be of inflammatory nature.

From six of the 44 cases (13 per cent), therefore, there is evidence of an underlying inflammatory process of some peculiar type. There were pain, redness and swelling of the eyelids—cardinal signs of infection—but in none was there the slightest indication of the character of the infection.

Although a demyelinizing process is conceivable (perhaps like that of multiple sclerosis), there is no proof. Moreover, with one exception, there has been but a single insult to the optic nerves, and after this has passed the cure has appeared to be permanent. One would expect repeated and long continued attacks if a demyelinization process were the cause.

The Cerebrospinal Fluid: Pressure.—The pressure of spinal fluid was

measured in nine cases, in only two of which were the readings in the higher reaches of normal—250 and 280. The actual readings were 80, 120, 120, 130, 170, 170, 170, 250 and 280.

In 24 cases, the flow of fluid from the ventricular fluid (tapped for ventriculography) was such as to indicate the absence of intracranial pressure. In two instances it was reported to have been slightly increased.

Cell Count.—Cells were counted in 22 cases. The highest count was 12; in the remaining it was 10 (one case) or less.

Globulin Content.—The fluid was examined for excess globulin, but in no instance, even the case of syphilis, was there an increased amount.

Roentgenograms and Ventriculography.—Roentgenograms of the head were made in nearly all cases, and in none was there a positive or even a suggestive finding. Ventriculograms were made in 37 cases, and since tumors were suspected, all injections of air were made through ventricular punctures. All showed normal, symmetrical ventricles, thereby unequivocally excluding intracranial tumors. In two instances, the ventricles were fairly large (both in older persons) and representing, we thought, the normal for those individuals. The ventricles, though small, were, on the whole, somewhat larger than in the group with papilledema and intracranial pressure but without brain tumor.

Vision.—Of the 44 cases, 41 complained of disturbance of vision. The most common complaint was dimness or blurring of vision. The degree of visual loss varied from a purely subjective disturbance without actual objective loss in any form to complete blindness. In 14, or approximately one-third of the cases, the visual acuity and visual fields were normal. In eight, there was unilateral loss of vision in some degree, and in 22, or 50 per cent, there was bilateral loss of some degree. In two-thirds of the total number there was visual loss.

In 19 cases, blind spots were enlarged on one or both sides, and in ten the blind spots were normal. In 13, there were scotomata or field defects of varying size.

Eyegrounds.—In every case there was papilledema in one or both eyes—42 bilateral and two unilateral. Hemorrhages were present in the eyegrounds in 19 cases (43 per cent); in five, the hemorrhages were unilateral and in 14 bilateral. The hemorrhages were usually petechial, but in two cases they were large and flame-shaped.

Ultimate Results.—Thirty-one cases have been traced, some by letters; others have returned for examination. Two are dead, one, 18 months later of chronic encephalitis, which was doubtless the lesion at the time of our examination; the other patient died eight years later following an abdominal operation. Only two of these patients are reported in less than a year after the initial study; seven have gone two years or less; four between two and three years; two between three and five years; nine between five and ten years; and seven more than ten years; the longest 14½ years.

In seeking the ultimate effects upon vision, the original cases have been

divided into four groups: Those with (1) papilledema only; (2) hemorrhages in the eyegrounds; (3) scotomata and enlarged blind spots; and (4) field defects.

Papilledema Only.—There were nine cases in this group, and in all the vision has remained normal both subjectively according to the patients' report and objectively in those who have come for examination in the check-up. Five of these are over ten years, the remaining between one and one-half and three and one-half years.

Hemorrhages in Eyegrounds.—Of the 13 cases with hemorrhages in the eyegrounds, one is blind and was blind at the time of our first study nine years earlier; a field defect remains in three; and in nine the vision is said to be normal.

The return of visual acuity in several of these patients is most striking. One patient's visual acuity returned from 12/200 to 20/70 (six and one-half years); another from 3/200 and 12/200 to 20/30 in each eye (three years); and another from 10/200 and 80/200 to 20/20 in each eye (six years).

Scotomata and Blind Spots.—Of 13 patients who have been followed, nine are now normal, and in four the vision has remained unchanged.

Field Defects.—This is the group with the most severe visual changes and with the poorest prognosis. Of 11 cases, the vision in seven has remained unchanged; in one, the vision returned to normal in one eye and is only useful in the other (one and one-half years later). At the time of the original study in the latter patient both eyes were essentially the same, he being practically blind. In the three remaining cases of this group the vision has returned to normal in both eyes. In one of these patients, blind when first seen, the visual acuity and visual fields are normal six years later. In another who was blind in one eye, the visual acuity and fields are again normal two years later.

SUMMARY AND CONCLUSIONS

(1) Forty-four cases of papilledema without intracranial pressure are presented. The underlying etiologic or pathologic basis is unknown, except that two cases of multiple sclerosis and two of encephalitis are included. No evidence of either of these lesions can be found in the remaining cases. A few of the cases appear to follow a mild nonspecific inflammatory process in the eye or lids, but these cases are distinctly in the minority.

(2) Although there is evidence of some intracranial involvement in some cases, in others there is none. Moreover, the papilledema may be unilateral, although it is much more commonly bilateral. On the whole, the pathologic process is decidedly local and any intracranial extension and its effects are usually mild and of little concern. Exceptions to this statement are, of course, the examples of encephalitis and multiple sclerosis.

(3) The condition carries no danger to life, and heals spontaneously in the course of a few weeks or months. No form of treatment is known to be effective. Certainly, all forms of operative intervention are contraindicated.

(4) Women are affected nearly three times as frequently as men. It occurs in all decades of life in about equal frequency, except the second, where it is two and one-half times as common.

(5) The outstanding symptom is loss of vision—usually a blurring at first. Scotomata, field defects and blindness may develop with great rapidity, and may or may not remain. Great defects of vision and visual acuity, even blindness, may disappear and even normal vision may return. Permanent blindness resulted in only one case. Hemorrhages in the eyegrounds occur with great frequency.

(6) There are no changes in the cerebrospinal fluid; the pressure is not increased. Ventriculograms are always normal.

(7) In only one case did the papilledema recur. This was three years after the initial attack and three years ago. On each occasion the vision was seriously defective, but returned almost to normal. The eyegrounds show only slight pallor of the disks. In another case, a dense scar fills the disk and obliterates all of its landmarks.

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HURTHLE CELL TUMORS OF THE THYROID

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IN A HURTHLE CELL TUMOR of the thyroid there is supposed to be a proliferation of cells similar to those described originally by Hurthle, in 1894. These cells are considered normal constituents of the thyroid and capable of reproducing thyroid tissue when necessary. This opinion is not universally accepted but it gives an insight into the type of structure that exists.

There are three opinions regarding the histogenesis of these tumors. The arguments in favor of each are equally convincing but as yet they have not been proved. It was regarded by Langendorff, and others, that the tumors arose from the cells first noted by Baber,[1] in 1874. These cells were later termed "*proto plasmeischen Zellen*" by Hurthle,[2] in 1894. They are thought to be para- or interfollicular cells, the function of which will be discussed later. In 1907, Sophia Getzowa[3] advanced the theory that these lesions had their origin from the rests of the primary postbranchial body or lateral thyroid anlage. The third opinion is that these tumors arise from normally located or ectopic parathyroid cells.

The morphologic characteristics have been thought to resemble the cells of the liver, parathyroid and adrenal cortex. The primary cells are large polyhedral, eosinophilic, granular structures, measuring from 15 to 20 microns, and containing chromatin in clumps. These cells, as is noted, are large, compactly arranged, and form small alveoli. The lumina are usually small with an absence of the normal thyroid arrangement, which in turn gives the tissue a solid appearance. The gross appearance may be that of a discrete, well encapsulated structure. On the other hand, there may be a diffuse invasion with the tumor cells surrounding normal tissue.

The gross and microscopic structure of the fetal adenoma resembles more the Hurthle cell tumors than other thyroid tumors. The fetal adenoma is composed of small cell alveoli, but the epithelial cells are somewhat smaller and more hyperchromatic. There is a distinct difference in the stroma. In fetal adenoma there are large areas of clear, loose connective tissue, whereas, in Hurthle tumors, the fibrous tissue is less.

A differentiation of the malignant types is not always easy, but the same criteria are applicable as in other types.[4] The morphology of the cell is not as significant as other characteristics, such as relationship to alveoli and gland. The invasion of the blood vessels is by far the most frequent characteristic of malignancy of the thyroid. There may be an involvement within the capillaries and larger veins with thrombi formation. Wilensky and Kauf-

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man,[5] in 1938, noted that four cases had been recorded as benign and six as malignant. It is reasonable to believe that many of both types have been encountered but never considered and reported as such. Therefore, we are reporting three additional cases, one of which is definitely malignant and the other two are questionable.

CASE REPORTS

Case 1.—S. N., Negro, female, age 46, was admitted to the Emory University division of Grady Hospital, September 3, 1937, complaining of enlargement of the neck, which had been present for ten years. She had had evidence of thyrotoxicosis two years prior to admission. There had been a slight loss of weight. The basal metabolism was normal. The left lobe of the thyroid was nodularly enlarged to about 4 cm. in diameter. It was freely movable and firm, but not hard. The physical examination was otherwise normal.

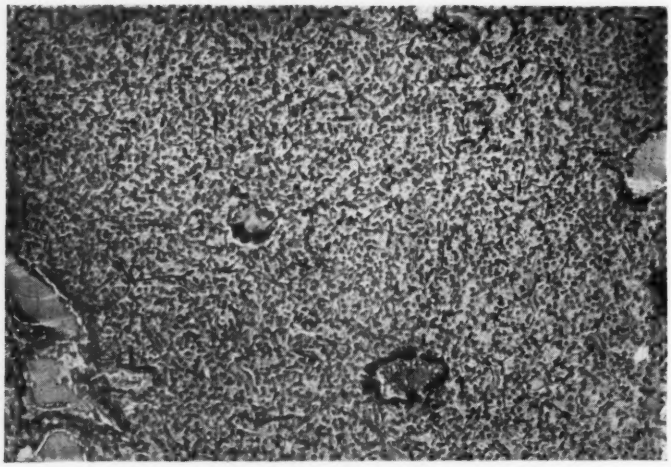

FIG. 1.—Case 1: Showing orderly arrangement of small alveoli containing a few large cells. There are scattered areas of colloid within the large cystic spaces. (Low power.)

On September 7, 1937, a nodular mass was removed from the left lobe of the thyroid, which extended 2 cm. beneath the sternum. The tumor was irregular but well encapsulated, measuring 3.5x4 cm. and involving practically the entire left lobe of the thyroid. On cut section three distinct nodules were present. Each was surrounded by a thick fibrous capsule. The surface was homogeneous, pale yellow in color. There was no resemblance to normal thyroid structure.

Histologic examination revealed an extremely cellular structure with numerous islands of compact epithelial cells attempting to form acini. The basement membrane was fairly distinct. The epithelial cells were large and granular in appearance. The alveoli were diminished in size and contained a small amount of colloid. The entire area was extremely vascular. *Diagnosis:* Benign Hurthle cell tumor of the thyroid.

Since removal, there has been no evidence of recurrence of disease.

Case 2.—J. A., Negro, female, age 38, was admitted to the Emory University division of Grady Hospital, November 9, 1936. The chief complaint was an enlargement of the thyroid. This had been present for five years as a small nodular mass in the right side of the neck. The patient had had frequent attacks of sore throat and

difficulty in swallowing for the two months prior to admission. She had marked dysphagia and dyspnea, particularly on lying flat in bed.

Physical examination showed a well developed and nourished Negro female. The right lobe of the thyroid was moderately enlarged, and was displacing the trachea to the opposite side. The remainder of the physical examination was normal except for a fibroid tumor of the uterus.

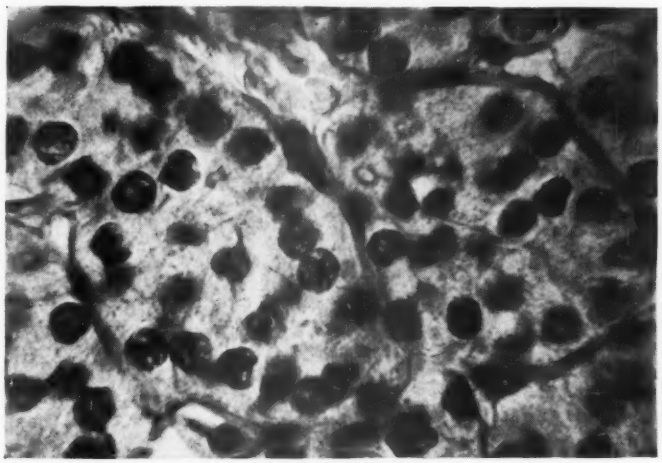

FIG. 2.—Case 1: Presenting compact small alveoli with large cells. The nuclei are polyhedral in shape and contain much granular material. The basement membrane is very prominent. (High power.)

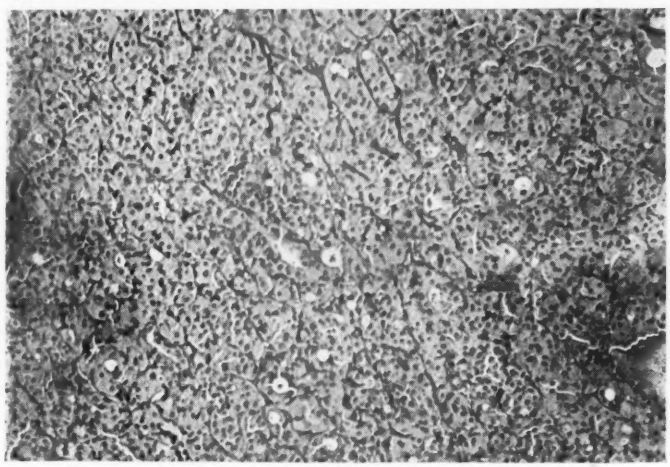

FIG. 3.—Case 2: Presenting typical large cells forming small alveoli. There are many vacuolated areas throughout with loose fibrous septa separating the alveoli. (Low power.)

Basal metabolism on admission to the hospital was plus 22. After ten days' bed rest the metabolism was plus five. Blood chemistry was normal, including blood cholesterol. The clinical diagnosis was mild toxic adenoma.

Operation was performed, November 14, 1936, which revealed an enlargement of the right lobe. This was nodular and measured 4 cm. in diameter and 6 cm. in length. The remainder of the thyroid was apparently normal.

Pathologic examination revealed a mass 6x3x3 cm. The surface was irregular and surrounded by a thick capsule. On cut section the tumor was a grayish-yellow with dense fibrous trabeculae dividing the mass. The substance was homogeneous between these areas. There was an absence of the normal colloidal appearance.

Histologic examination revealed many cystic spaces lined by a flat type of epithelium. Between these cystic areas there was a different cellular structure which consisted of

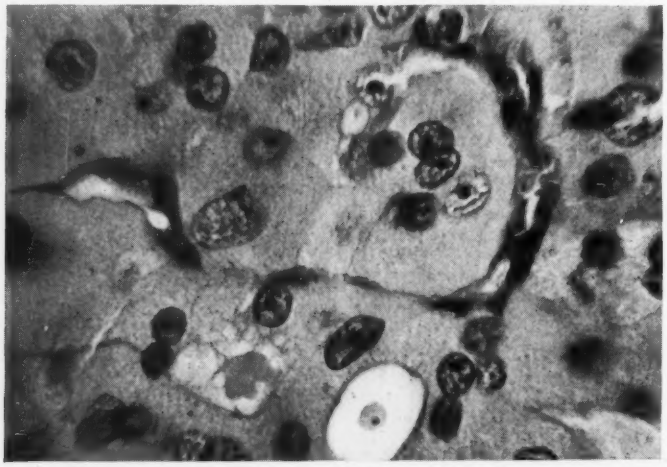

FIG. 4.—Case 2: Showing the large polyhedral-shaped cells with prominent granular nuclei. (High power.)

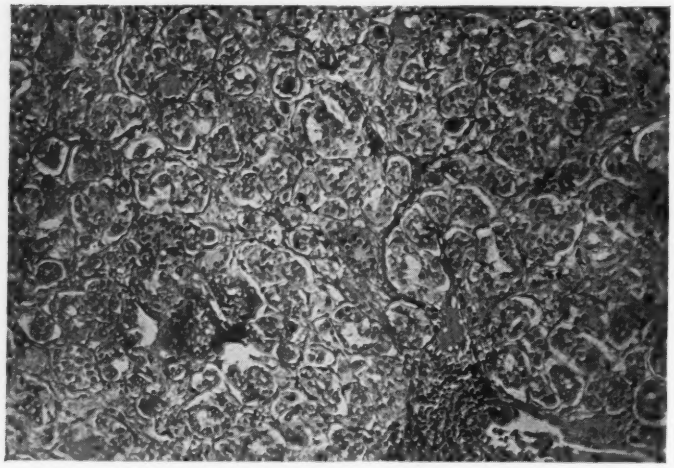

FIG. 5.—Case 3: An adenocarcinoma which presents a cellular structure composed of large cells forming irregular sizes and shapes of alveoli. (Low power.)

large pale cells and contained considerable granular material. The nuclei were large, granular and ovoid in shape. There was very little stroma and no evidence of hyperplasia. *Diagnosis:* Hurthle cell tumor.

There has been no evidence of recurrence of the disease.

Case 3.—E. H., Negro, female, age 54, was admitted to the Emory University division of Grady Hospital, April 27, 1937, complaining of hoarseness and enlargement of the glands of the neck. Patient stated that, for about 3 years, she had noticed two

small nodules in the lower part of the right side of her neck. These remained unchanged until about six months before admission, when they began to increase in size and to cause difficulty in breathing. Soon afterwards she became hoarse and had continued so until admission. She had lost 25 pounds in weight over a period of two years.

Physical examination revealed numerous nodules adjacent to the thyroid cartilage and extending on the inner side of the right sternomastoid muscle accompanying the internal jugular vein. There were five discrete nodules along this area. The thyroid gland was enlarged, irregular in shape and slightly tender. The remainder of the physical examination and laboratory findings were negative.

On May 1, 1937, a small nodule measuring 2 cm. in diameter was removed for diagnosis. On cut section the surface was roughened and had a yellowish-white color.

Microscopic examination revealed a thickened capsule enclosing large epithelial cells which contained hyperchromatic nuclei. These cells were attempting to form regular acini in which there were small amounts of colloid. The acini were small in

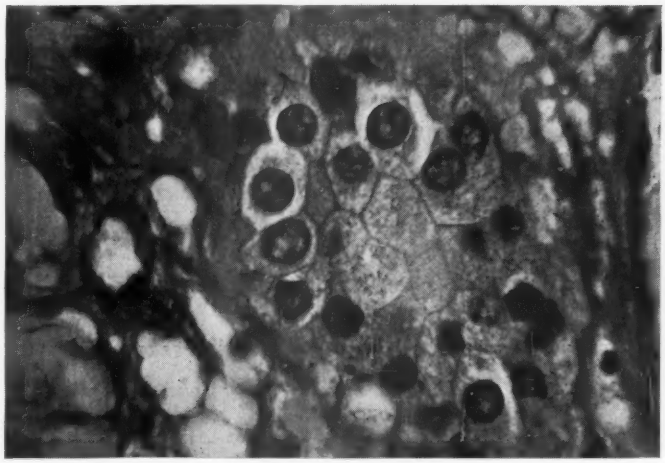

FIG. 6.—Case 3: Presenting typical large epithelial cells with very prominent cell walls. There are many chromophobic vacuoles and mitoses. (High power.)

type and the basement membrane was indistinct. The nuclei were very granular and contained many mitotic figures. The stroma consisted of loose connective tissue which was surrounded by many thick-walled blood vessels. An occasional foreign body type of giant cell was seen. *Diagnosis:* Malignant Hurthle cell tumor of the thyroid.

At operation, May 8, 1937, the sternomastoid muscle and the internal jugular vein on the right side were removed with accompanying lymph nodes. The right lobe of the thyroid was found diseased, but the left was apparently normal. The right lobe consisted of an extremely nodular and hardened gland which was densely adherent to all the surrounding structures. The right lobe measured 4x3 cm. On cut section there were many large cystic spaces which contained greenish gelatinous material. Between these areas was a solid structure which was pale in color. There was no evidence of normal thyroid tissue in the right lobe.

Histologic section was similar to that seen in the previously examined lymph node. The cells were large and formed irregularly shaped small acini. The nuclei were prominent and contained considerable granular material. Mitoses were numerous. There were scattered areas of calcification through the entire lobe. *Diagnosis:* Malignant Hurthle cell tumor of the thyroid.

The patient recovered from this procedure without incident. Roentgenograms of

the long bones were negative for metastases. She was given postoperative irradiation over the neck and the region of the thyroid. There has been no evidence of recurrence of the tumor.

Discussion.—In order to evaluate the various theories regarding the histogenesis of these tumors, it is first necessary to review some of the concepts of development and function of the thyroid.

Since the description of the formation of the follicle by the early investigators, namely, Baber and Hurthle, much difference of opinion has arisen concerning the method of formation and the function of the follicles with particular reference to the relation of the colloid.

Hurthle[2] believed that there were two types of interfollicular cells. The difference was mainly in the size and the content of the protoplasm. The small cells were usually round in shape, whereas the large ones were seldom so. In the development a group of the larger cells came together and formed alveoli. These cells are probably the same as Baber's parenchyma cells, which are large interfollicular cells, rich in protoplasm, finely granulated and with a single large nucleus. Baber[1] first thought the cells were outside of the follicles and that the epithelial wall was flattened and moved aside, thus allowing the cells to finally reach the interior of the follicle and become a part of the colloid content. Hurthle, however, failed to concur in this opinion as to the fate of these cells.

Zechel[6, 7] believed that there were two types of cells. The first were the epithelial cells which were the most prevalent type. The second were the large cells which were located in the interfollicular spaces. The function of the latter was the formation of new follicles, production of colloid and the possible inception of follicular destruction.

Nonidez[1] agreed with the occurrence and formation of parafollicular cells but believed they are separate from the glandular epithelium. This opinion was strengthened by Takagi, in 1922. He was able to show a difference in the staining characteristics of the cells.

Marine and Lenhart[8] considered the follicles to be the unit of structure, which were round or oval closed spaces lined by cuboidal epithelium. Williamson and Pearse[9] thought the thyroid was divided by interstitial tissue into lobules. These lobules were thought to be closed by a meshwork of fibroelastic tissue which supports the endothelium of the lymphatic sinusoids. This was an expansion of the intralobular lymphatics. The coiled columns of epithelium were located within the sinusoids. The columns of epithelium were surrounded by a peculiar ladder-like plexus of capillaries.

Gale Wilson[10] studied normal and abnormal thyroids and was unable to find such a unit structure as Williamson and Pearse. She considered, also, the process of vesiculation to be the means whereby the continuity of the follicles was maintained. The follicles are thought to be separate, and not to have individual lobules bathed by lymphatics. These developmental and anatomic beliefs aid in supporting and furnishing evidence for the interfollicular theory of formation.

Getzowa[3] presumed that the cysts seen in the atrophied thyroids of cretins and idiots were probably rests of the primary lumen of the postbranchial body. It was also concluded that the histologic structure of the cell masses is not comparable to the thyroid or parathyroid as they are composed of large protoplasm-rich cells and often contain cilia in the small lumen. The author believed these masses to be remnants of the glandular parenchyma of the postbranchial cell masses. These cells were similar to, if not identical with, the epithelial cells of the large cell, small alveolar tumors described by Langhans.

Eisenberg and Wallerstein[11] were firm believers of the parathyroid theory of formation of these tumors. It was thought that the cells arose from parathyroid cells either within or outside the thyroid. The belief was based on the description of the principle and chief cells of the parathyroid made by Welsh, in 1898. The similarity of the oxyphilic cells described by Hurthle was noted by this investigation.

There is no unanimity of opinion concerning the origin of these tumors, but the histologic structure is well understood. Ewing's[12] description explains the fundamental structure in that they are "small, well formed alveoli lined by one or more layers of irregular cells. Some are clear, cuboidal or cylindrical or irregularly polyhedral. Others are large, sometimes giant size, finely granular eosinophilic, and opaque, resembling granular suprarenal or liver cells. The nuclei are small and vesicular in type with prominent nucleoli. Rather numerous globules of colloid are usually present and the original structure reappears in metastasis."

Ewing classifies these tumors as "small alveolar, large cell adenocarcinoma," as Langhans originally did. Contrary to the belief of many, he considers all of these tumors malignant.

There is no essential difference in the course of these tumors and similar ones of the thyroid. The important feature is the recognition of the malignant and benign types. There has been inadequate investigation to determine whether these malignant growths begin from benign lesions or if these types develop as separate tumors, as in other types of adenomata.

The treatment should be early surgical removal. It is obvious that diagnosis of this type of thyroid will not be made until after removal. It is frequently impossible to recognize the malignancies, as the one reported here was not seen until regional metastasis had occurred.

SUMMARY

(1) Three cases of so-called Hurthle cell tumor of the thyroid are reported. Two are classified as benign and one as malignant.

(2) The possible origin of these tumors is presented. As yet, there is no unanimous opinion regarding their histogenesis.

(3) The clinical course and treatment of these lesions are similar to other thyroid adenomata, both the benign and malignant types.

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RETROPHARYNGEAL AND LATERAL PHARYNGEAL ABSCESSES

An Anatomic and Clinical Study

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Retropharyngeal and lateral pharyngeal abscesses have been recognized and described under various terms (pharyngeal abscess, pharyngomaxillary abscess, postpharyngeal abscess, abscess of the neck, phlegmon of the neck, pterygomaxillary abscess, *etc.*) for a long time. According to Holmes (1907), Galen referred to a case of retropharyngeal abscess. Allin (1851) stated that the earliest mention of abscess behind the pharynx is to be found in the works of Platerus, in 1625. Horner (1818) described a case starting from ulcerations of the tonsil. Abercrombie described three cases, in 1819, and Fleming two cases, in 1850. Among other early reports and discussions were those of Taylor (1846), Henoch, in 1850 (Holmes, 1907), Pretty (1858), Bokai, Sr., in 1876 (Holmes, 1907), Chiene (1877), Elliot (1879), Smith (1879), Savoy (1880), Allen (1881), Cheyne (1881), Agnew (1882), McCoy (1882), Sands, (1882), Tyler (1882), Parker (1883), de Blois (1885), Clutton (1887), Burckhardt (1888), Hawkins-Ambler (1891), Berg (1894), Bokai, Jr., in 1896 (Holmes, 1907), and Koplik (1896).

Morse (1903) discussed the etiology and pathologic anatomy in detail. Similar descriptions were made by Meierhof (1905), Waugh (1906), Sheedy (1912), Badgerow (1912), Alexander and Montague (1913), McKenzie (1915), Fulkerson (1916), Richardson (1920), Waldapfel (1928), and Beck (1932). Travers (1902), Palmer (1933), and Salinger and Pearlman (1937) emphasized secondary hemorrhage from erosion of the large vessels of the neck.

Drainage of the superior and posterior mediastinum by cervical and thoracic approaches was described by Nasiloff (1888), Quenu and Hartmann (1891), Bryant (1895), Rehn (1898), Heidenhain (1899), Von Hacker (1901), Guadiani (1916), Lerche (1921–1924), and Lilienthal (1923). Dean (1919) described a method of external drainage for abscesses secondary to caries of the vertebrae. Mosher (1920 and 1929) discussed the fasciae and fascial compartments of the neck, emphasized the importance of thrombosis of the internal jugular vein and described incisions for drainage. Furstenberg (1929) described the fascial layers and compartments in the neck, and discussed the routes of spread from the nose and throat to the posterior mediastinum. He also discussed cervical (collar) and thoracic (dorsal) mediastinotomy. Kanavel (1922) described two cases treated by external incision. Numerous other articles, mostly case reports, have been found in the literature.

In a previous article (Grodinsky and Holyoke, 1938), a description of the fasciae of the head, neck and adjacent regions has been given based on the

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Figures 1 to 3, inclusive, are diagrammatic drawings based upon data of dissections, sections and injections of adult and fetal material.

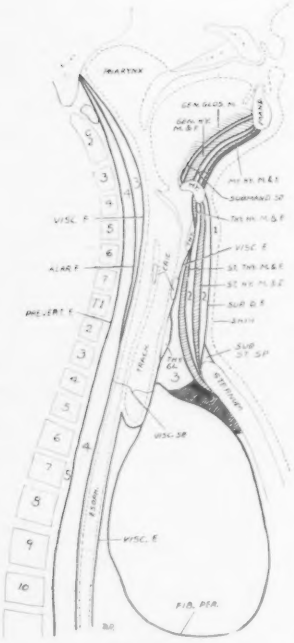

FIG. 1.—Diagrammatic drawing of fasciae of head and neck in midsagittal section.

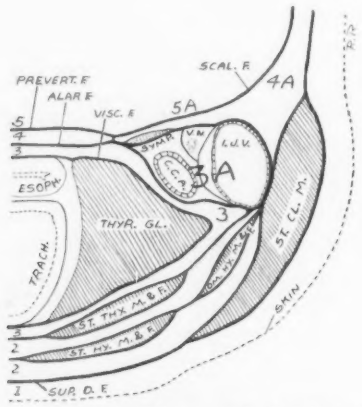

FIG. 2.—Diagrammatic drawing of fasciae of neck. Transverse section approximately at the level of the 6th cervical vertebra.

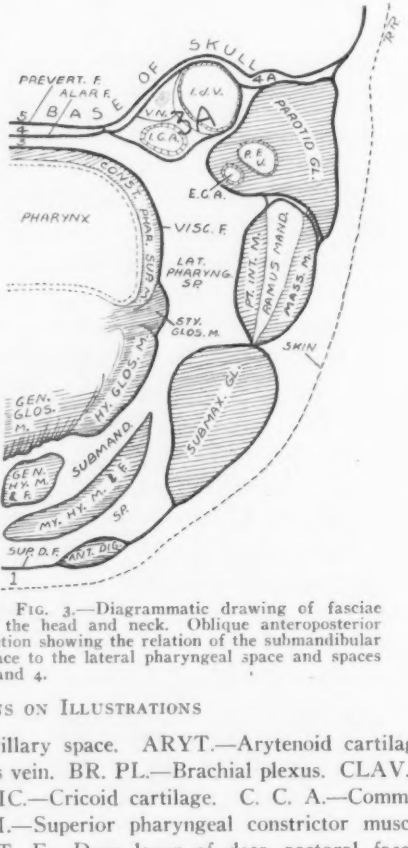

FIG. 3.—Diagrammatic drawing of fasciae of the head and neck. Oblique anteroposterior section showing the relation of the submandibular space to the lateral pharyngeal space and spaces 3 and 4.

KEY TO ABBREVIATIONS ON ILLUSTRATIONS

ALAR F.—Alar fascia. AX. SP.—Axillary space. ARYT.—Arytenoid cartilage. A. AOR.—Ascending aorta. AZ. V.—Azygos vein. BR. PL.—Brachial plexus. CLAV.—Clavicle. COROC.—Coracoid process. CRIC.—Cricoid cartilage. C. C. A.—Common carotid artery. CONST. PHAR. SUP. M.—Superior pharyngeal constrictor muscle. D. AOR.—Descending aorta. D. D. PECT. F.—Deep layer of deep pectoral fascia.

study of 75 adult cadavers and five full term fetuses by dissection, injection and section methods. In a second article (Grodinsky, 1938), this description was reviewed with special reference to its application to the clinical entity known as Ludwig's angina. It is my purpose in this article to review this anatomic description with special reference to retropharyngeal abscess and to discuss the clinical picture and treatment.

ANATOMY.—*Layers of Fasciae: The superficial fascia* is a continuous sheet of fatty tissue extending from the head and neck into the regions of the thorax, shoulders and axillae. In the neck it is a moderately loose layer containing the platysma muscle in its deep portion. In the face the superficial fascia is very adherent to the overlying skin and contains the muscles of expression in its deep portion.

The superficial layer of deep fascia crosses the anterior triangle of the neck, splits to form the sheath of the sternocleidomastoid muscle, crosses the posterior triangle, splits to form the sheath of the trapezius muscle, and finally attaches to the spines of the vertebrae in the midline posteriorly. In the midline anteriorly, it splits to form the suprasternal space of Burns, its anterior and posterior leaflets attaching to the corresponding margins of the sternum. Lateral to the sternum, it is attached inferiorly to the clavicle, acromium, and spine of the scapula. A corresponding layer, the superficial layer of deep pectoral fascia, then continues from the anterior inferior surface of the clavicle

DELT. M.—Deltoid muscle. DIG. ANT. M.—Digastric muscle, anterior belly. DIG. POST. M.—Digastric muscle, posterior belly. E. C. A.—External carotid artery. EPIGL.—Epiglottis. ESOPH.—Esophagus. EUST. TUBE.—Eustachian tube. GEN. GLOS. M.—Genioglossus muscle. GEN. HY. M.—Geniohyoid muscle. GLOT.—Glottis. HY.—Hyoid bone. HY. GLOS. M.—Hyoglossus muscle. I. C. A.—Internal carotid artery. I. J. V.—Internal jugular vein. L. LUNG.—Left lung. LEV. VEL. PAL. M.—Levator veli palatini muscle. LAT. PHARYNG. SP.—Lateral pharyngeal space. MAND.—Mandible. MASTIC. SP.—Masticator space. MAST. PROC.—Mastoid process. MAX. S.—Maxillary sinus. MY. HY. M.—Mylohyoid muscle. OCCIP. BONE.—Occipital bone. OM. HY. M.—Omohyoid muscle. P. A.—Pulmonary artery. PAROT. GL.—Parotid gland. PECT. MAJ. M.—Pectoralis major muscle. P. F. V.—Posterior fascial vein. PREVERT. F.—Prevertebral fascia. PT. INT. M.—Internal pterygoid muscle. PT. EXT. M.—External pterygoid muscle. PHR. N.—Phrenic nerve. PAR. PL.—Parietal pleura. R. LUNG.—Right lung. SCAL. F.—Scalenus fascia. SCAL. ANT. M.—Scalenus anterior muscle. SCAL. MED. M.—Scalenus medius muscle. SCAL. POST. M.—Scalenus posterior muscle. ST.—Sternum. SCAP.—Scapula. SUP. D. F.—Superficial layer of deep fascia. SUP. D. PECT. F.—Superficial layer of deep pectoral fascia. SUBMAND. SP.—Submandibular space. SUP. ST. SP.—Suprasternal space. SUBMAX. GL.—Submaxillary gland. S. V. C.—Superior vena cava. ST. CL. M.—Sternocleidomastoid muscle. ST. HY. M.—Sternohyoid muscle. ST. THY. M.—Sternothyroid muscle. STY. HY. M.—Stylohyoid muscle. STY. GLOS. M.—Styloglossus muscle. STY. PHAR M.—Stylopharyngeus muscle. SUBCLAV. M.—Subclavius muscle. SYM.—Sympathetic trunk. TEMP. M.—Temporalis muscle. THY.—Thyroid cartilage. THY. GL.—Thyroid gland. THYM. GL.—Thymus gland. TRACH.—Trachea. TRANS. F.—Transversalis fascia. TEN. VEL. PAL. M.—Tensor veli palatini muscle. TRAP. M.—Trapezius muscle. THY. HY. M.—Thyrohyoid muscle. VISC. F.—Visceral fascia. VISC. PL.—Visceral pleura. VISC. SP.—Visceral space. V. N.—Vagus nerve. ZYG.—Zygoma.

around the pectoralis major muscle, and at the lateral inferior border of this muscle becomes the deep axillary fascia, which crosses the axilla and splits to form the sheath of the latissimus dorsi muscle. (Figs. 1, 2, 6 and 7)

Superiorly the superficial layer of deep fascia attaches to the hyoid bone, and proceeds across the submental and submaxillary triangles (submandibular space). It fuses with the sheath of the anterior belly of the digastric muscle, although the two layers may be easily separated. It also becomes attached to the sheaths of the stylohyoid muscle and the posterior belly of the digastric muscle, and then splits to form the capsule of the submaxillary salivary gland. This is a completely closed capsule which attaches superiorly by two slips to the superficial and deep margins of the body of the mandible. The anterior belly of the digastric, the mylohyoid, the geniohyoid, the genioglossus, and the hyoglossus have independent sheaths with bony attachments at the attachments of these muscles. (Figs. 1, 3, 5 and 9)

Figures 4 to 9, inclusive, are line drawings made on bleached photographs of serial sections of human material.

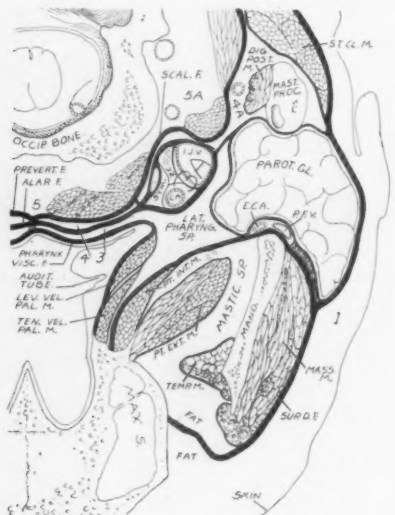

FIG. 4.—Transverse section of adult cadaver at level of hard palate. Superior view.

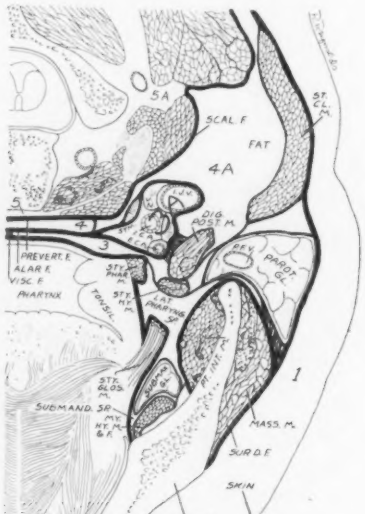

FIG. 5.—Transverse section of adult cadaver through the tongue and the palatine tonsil. Superior view.

Between the angle of the jaw and the anterior border of the sternocleidomastoid muscle, the superficial layer of deep fascia splits to form the capsule of the parotid gland, which in our experience is complete on all sides. From the body of the mandible, the superficial layer of deep fascia extends superiorly to form the sheath of the masseter muscle and attaches to the zygoma above. It then continues superiorly over the temporal muscle as the outer layer of deep temporal fascia. At the anterior and posterior borders of the masseter, it passes around the corresponding borders of the ramus of the mandible and

becomes continuous with the sheaths of the pterygoid muscles, thus completing the walls of the masticater space (see below). (Figs. 3, 4, 5 and 9)

The middle layer of deep fascia consists of three subdivisions: The *sternohyoid-omohyoid layer,* the *sternothyroid-thyrohyoid layer* and the *visceral layer.* The former is continuous across the midline anteriorly, forms the sheaths of the sternohyoid and omohyoid muscles, and attaches to the deep surface of the sternocleidomastoid sheath, where it forms a pulley between the anterior and posterior bellies of the omohyoid muscle. Superiorly it is attached to the hyoid bone and, more laterally, to the overlying superficial layer of deep fascia and underlying sternothyroid-thyrohyoid layer along the superolateral border of the anterior belly of the omohyoid muscle. Likewise, in the posterior triangle, it is attached along the superolateral border of the posterior belly of the omohyoid muscle to the superficial layer of deep fascia. Inferiorly this layer is attached to the sternum, clavicle, and scapula. A corresponding layer, the deep layer of deep pectoral fascia, starts at the clavicle, splits to form the sheath of the subclavius muscle, becomes the costocoracoid membrane, splits to form the sheath of the pectoralis minor muscle, and becomes the suspensory ligament of the axilla which runs into the axillary fascia. (Figs. 1, 2, 6 and 7)

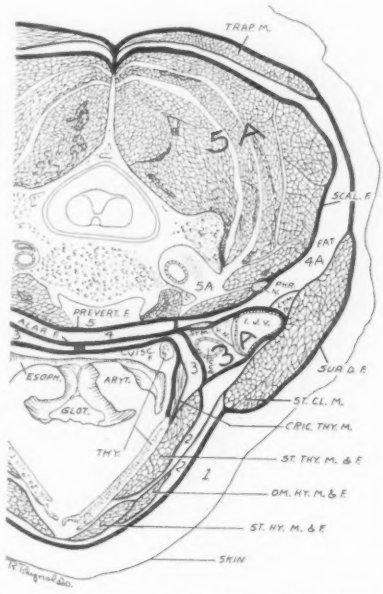

FIG. 6.—Transverse section of adult cadaver at the level of the thyroid cartilage. Superior view.

The sternothyroid-thyrohyoid layer crosses the midline anteriorly, splits to form the sheaths of the muscles indicated in the name, and runs laterally into the deep surface of the sternocleidomastoid sheath, fusing here with the carotid sheath. Inferiorly it attaches to the sternum and clavicle. Superiorly it attaches to the thyroid cartilage and hyoid bone; more laterally to the superficial layer of deep fascia and the sternohyoid-omothyoid layer superficially, and the carotid sheath deeply. (Figs. 1, 2, 6 and 7)

The visceral fascia completely surrounds the thyroid gland, trachea and esophagus. Superiorly it extends to the base of the skull on the posterior side, and to the thyroid cartilage and hyoid bone on the anterior and lateral sides. Inferiorly, at the root of the neck, it fuses with the alar fascia of the anterior wall of the carotid sheath, and becomes continuous with the fibrous pericardium covering the heart and great vessels of the thorax. It also continues inferiorly as the covering of the thoracic portion of the trachea and esophagus. (Figs. 1 to 8)

Deep Layer of Deep Fascia.—There are two main subdivisions: The *alar*

and *prevertebral* fasciae, including the continuations of the latter, *e.g.*, scalenus, transversalis, and Sibson's fasciae.

The alar fascia extends across the midline posterior to the pharynx, esophagus and visceral fascia, and fuses with the prevertebral fascia at the tips of the transverse processes, to which both these layers are attached. It then passes anterolaterally to form the medial wall of the carotid sheath, fusing with the sternothyroid layer and the deep surface of the sternocleidomastoid sheath. It also forms the posterior and lateral walls of the carotid sheath, again fusing with the deep surface of the sternocleidomastoid sheath and thus forming a complete sheath of alar fascia, the carotid sheath. Posteriorly, between the transverse processes, the alar fascia extends from the base of the skull to about the level of the seventh cervical vertebra, where it becomes intimately fused with the visceral fascia. (Figs. 1 to 8)

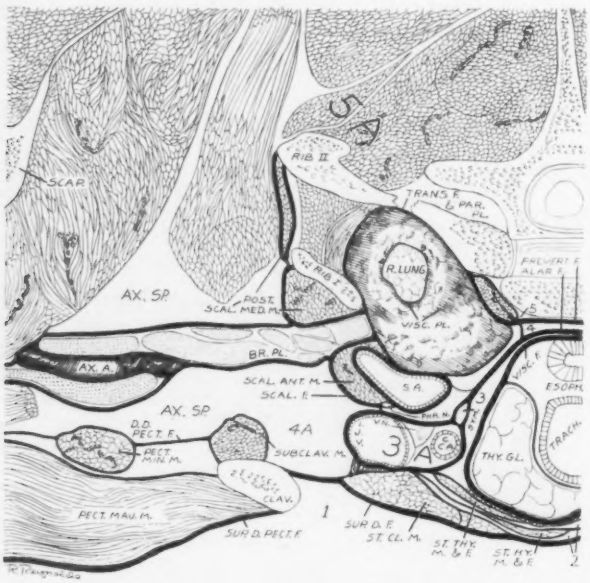

FIG. 7.—Transverse section of adult cadaver through the root of the neck. Superior view.

The prevertebral layer lies just anterior to the bodies of the vertebrae from the base of the skull to the coccyx. In the neck, it extends laterally to the tips of the transverse processes where it is fused both to these processes and to the alar fascia. Lateral to the transverse processes, it becomes the scalenus fascia which forms the sheaths of the scaleni, splenius capitus, levator scapulae and the other deep muscles of the back of the neck, and finally attaches to the spines of the vertebrae. Inferolaterally the scalenus fascia, after giving origin to the axillary sheath enclosing the axillary vessels and brachial plexus, attaches to the first and second ribs. In the thoracic and abdominal regions, the lateral extension of the prevertebral fascia becomes the extrapleuroperitoneal or transversalis fascia. Over the dome of the pleura, it is identical with the layer often described as Sibson's fascia. (Figs. 1 to 8)

Fascial Spaces: Superficial Space 1.—This is the potential space between the skin and deep fascia, that is, within the superficial fascia. It is the seat of superficial cellulitis and is continuous from region to region; in this case from head to neck and trunk. In the neck it may be subdivided into superficial and deep portions by the platysma muscle, both divisions being fairly loose and allowing rather large accumulations of fluids. (Figs. 1 to 7, and 9)

The deep fascial spaces may be considered under two headings: Those of the *infrahyoid* region and those of the *suprahyoid* region. For convenience we have roughly divided the infrahyoid spaces into those of the anterior and posterior triangles, the former being designated by numerals and the latter by corresponding numerals followed by the letter "A."

Infrahyoid Spaces: Space 2.—This is the potential space between the superficial layer of deep fascia and the deep layer of the sternothyroid-thyrohyoid sheath. It contains, therefore, the sternohyoid-omohyoid muscles with their sheaths, and the sternothyroid-thyrohyoid muscles with the anterior layer of their sheaths. The extent of the space was demonstrated by injections of gelatin colored with India ink, as well as by study of dissections and sections. It is continuous across the midline and is blind laterally where the sternohyoid and sternothyroid layers fuse to the deep surface of the sternocleidomastoid sheath. It is also blind superiorly at the hyoid bone, superolaterally along the superolateral border of the anterior belly of the omohyoid, and inferiorly at the sternum and clavicle. The most frequent extensions of injected masses from this space were along the pulley of the omohyoid to Space 2A, superficially into Space 1, and deeply into Space 3. (Figs. 1, 2, 6, 7 and 9)

Space 2A.—This space, between the superficial layer of deep fascia and the sheath of the posterior belly of the omohyoid muscle, is blind anteriorly at the pulley, posteriorly at the insertion of the omohyoid (posterior belly), posterosuperiorly along the posterosuperior border of that muscle, and inferiorly at the clavicle. The most common extensions from this space were along the pulley into Space 2, and into Spaces 1 and 4A. (Fig. 7)

Space 3.—This is the potential space between the visceral fascia on the one hand, and the sternothyroid layer, carotid sheath and alar fascia on the other. It thus has anterior, lateral, and posterior portions, all continuous. On the posterior side, it extends from the base of the skull to the level of the seventh cervical vertebra, where it is shut off by the close fusion of the visceral and alar layers. On the anterior side, it extends from the thyroid cartilage to the upper border of the arch of the aorta (fourth thoracic vertebra), where it is shut off by dense adhesions between the fibrous pericardium and the sternum. Laterally this space is blind at the root of the neck, where there are dense adhesions between the alar and visceral fasciae around the inferior thyroid arteries. Injected masses tended to remain localized within this space (3) but, when spread did occur, it was usually into Spaces 2 and 4, and inferiorly into the superior mediastinum slightly lower than the normal limits of the space. This is of special importance in retropharyngeal abscess. Retropharyngeal abscess may thus be confined within the visceral space (between the pharyngeal wall and the visceral fascia) or within Space 3 (between the

visceral and alar fasciae), the extension from the nose and throat occurring by lymphatics or direct continuity. Space 3, as we shall see, is directly continuous with the lateral pharyngeal or pharyngomaxillary space. However, retropharyngeal abscess may also involve Space 4 (see below) either by direct lymphatic extension from the nose and throat or by extension through the alar fascia from Space 3. (Figs. 1 to 7)

Space 3A.—This is the potential space within the carotid sheath. Primary injections into this space were usually limited closely to the region of injection, but in some cases extended as high as the hyoid bone and as low as the root of the neck, beyond which levels the close adherence of the sheath to the

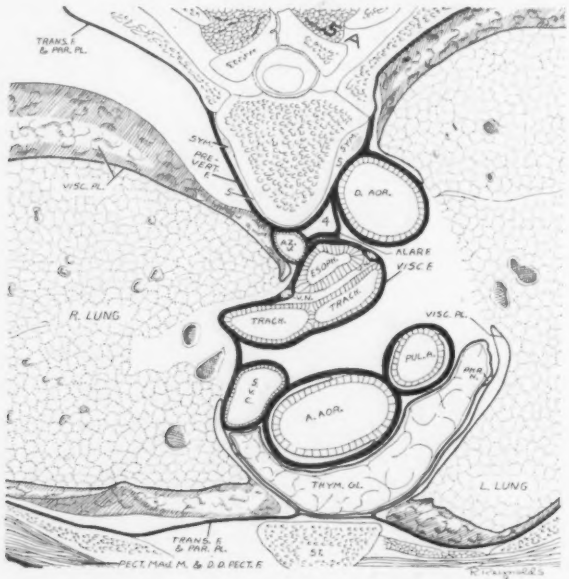

FIG. 8.—Transverse section of adult cadaver through the superior mediastinum. Superior view.

contained structures made further spread impossible. The space therefore bears little relation to infections of the head and neck except those associated with thrombosis within the internal jugular vein and with the lymph nodes lying within the sheath. According to Mosher (1920 and 1929), thrombosis of the internal jugular vein occurs either by primary extension of infected emboli from the veins of the nose and throat where retropharyngeal abscess begins; or secondary to adenitis and paradenitis of the retropharyngeal, lateral pharyngeal (deep parotid) or pendent groups of lymph nodes which drain the nose and throat. Waldapfel (1928) demonstrated the presence of thrombi in the tonsillar veins, but stated that nevertheless thrombosis plays but a minor rôle and that the primary aim should be drainage of the infected focus, *e.g.*, the lateral pharyngeal space which the pus reaches by lymphatics or direct extension from the nose and throat. According to him, ligation of the internal jugular vein is of secondary importance. It may be done if easily accessible, but is not absolutely necessary. (Figs. 2 to 7)

Space 4.—This space, often referred to as the "danger space," is the loose areolar space between the alar and prevertebral fasciae. It is limited laterally where these layers fuse at the tips of the transverse processes. It extends superiorly to the base of the skull and inferiorly into the posterior mediastinum. It is because of the latter relationship that it is often called the "danger space." There was very little tendency for injected masses to spread beyond this space, the most common being into Space 4A. However, extension did occur from other spaces into this space, especially from Space 3. It is in this way that Ludwig's infection and retropharyngeal abscesses find their way into the posterior mediastinum. As stated above, retropharyngeal abscess may start in Space 4 (by lymphatic extension from the nose and throat) or may secondarily extend into Space 4 from Space 3. (Figs. 1 to 8)

Space 4A.—This is the potential space between the superficial layer of deep fascia and the scalenus fascia. In the subclavian triangle, it lies between the sheath of the posterior belly of the omohyoid muscle and the scalenus fascia. This space is continuous with the axilla, but a rather dense fatty pad between the clavicle and first rib makes this communication less free. (Figs. 2 to 7)

Space 5.—This is the potential space between the prevertebral fascia and the bodies of the vertebrae. It extends from the base of the skull to the coccyx and is limited laterally by the attachment of the prevertebral fascia to the transverse processes. There was very little tendency for injected masses to rupture through the walls of Space 5 into Spaces 4, 4A, and 5A. However, this did occur at times. Space 5 is the space involved in tuberculosis of the bodies of the vertebrae, resulting in cold abscesses. These usually extend inferiorly posterior to the prevertebral fascia along muscles taking origin from the vertebral bodies (psoas abscess). Sometimes they remain localized in the cervical region. They either stay posterior to the prevertebral fascia (in Space 5) or rupture through that layer and enter Space 4. However, the typical retropharyngeal abscess originates in the nose and throat and the typical cold abscess gravitates to a lower plane within Space 5. (Figs. 1 to 8)

Space 5A.—This space, posterior to the scalenus fascia, lies between the deep muscles of the back of the neck. Infections within it extend superiorly and inferiorly along these muscles, thus sometimes traveling great distances. (Figs. 2 and 4 to 8)

Suprahyoid Spaces: The Masticator, Temporal and Parotid Spaces.—The *masticator* space is bounded by the superficial layer of deep fascia which, after forming the sheath of the masseter muscle, passes around the anterior and posterior borders of the ramus of the mandible and becomes continuous with the sheaths of the pterygoid muscles. The space thus contains the masseter muscle, the external and internal pterygoid muscles, and the ramus of the mandible. It is closed on all sides except superiorly, where it is in relation with the *temporal* space, deep to the deep temporal fascia. Injections into either space spread to the other, and under increased pressure, ruptured either superficially through the masseter sheath, or deeply into the parotid

space or lateral pharyngeal and submandibular spaces. The *parotid* space was found to be a completely closed space formed by a split of the superficial layer of deep fascia and occupied by the parotid gland, external carotid artery, and posterior facial vein. Injections made into this space showed infiltration into the substance of the gland and ruptures through the capsule: superficially with subcutaneous collections and deeply with extensions into the masticator, lateral pharyngeal, and submandibular spaces. (Figs. 3, 4, 5 and 9)

The Lateral Pharyngeal Space.—This important fascial space of the head is bounded by the pharynx, medially; the styloid muscles and carotid sheath, posteriorly; the parotid gland, posterolaterally; the mandible, pterygoids and masseter, anterolaterally; and the pterygomandibular raphe, anteriorly. Superiorly it extends to the base of the skull and inferiorly it is shut off from the neck by the attachment of the submaxillary capsule to the sheaths of the stylohyoid and the posterior belly of the digastric muscles. Inferomedially it communicates freely with the submandibular space deep to the submaxillary capsule. Posteromedially it communicates with Space 3. Injections made through the palatine tonsil and lateral pharyngeal wall went directly into the lateral pharyngeal space. From here, the injected masses spread easily into Space 3 and, in some cases, ruptured through the alar fascia into "danger space" 4. Extensions into the submandibular space took place freely. The lateral pharyngeal space is therefore infected from tonsillar abscesses, from retropharyngeal abscesses involving Space 3, and secondarily from the floor of the mouth through the submandibular space. Likewise, infections in this space may spread to the submandibular space and, in the later stages, resemble true Ludwig's angina. (Figs. 3, 4, 5 and 9)

The "Submandibular Space."—We have coined the term "submandibular space" to include the regions of the submental and submaxillary triangles lying between the mucous membrane of the floor of the mouth and the superficial layer of deep fascia over these regions. It thus encloses the sublingual and submaxillary salivary glands (the latter in a complete capsule), the genioglossus, geniohyoid, mylohyoid and digastric (anterior belly) muscles. The floor or deep wall of this space is made up of the hyoglossus muscle and superior pharyngeal constrictor, the latter covered by visceral fascia. Thus a group of potential spaces, all communicating, is established between the submental muscles, crossing the midline and extending deep to the capsule of the submaxillary salivary gland, superolaterally, to become continuous with the lateral pharyngeal space. This group of spaces, collectively making up the submandibular space, is limited inferiorly at the hyoid bone where the submental muscles and their sheaths attach; and inferolaterally at the inferior borders of the stylohyoid and posterior belly of the digastric muscles, the sheaths which are attached to the superficial layer of deep fascia superficially and the carotid sheath deeply. (Figs. 3, 5 and 9)

Injections, made through the mucous membrane of the floor of the mouth, anywhere from the midline anteriorly to the anterior tonsillar pillar posteriorly,

passed into the submandibular space. The more anterior injections first passed between the submental muscles and then spread laterally toward the lateral pharyngeal space deep to the submaxillary salivary gland. The more posterior injections passed into the lateral pharyngeal space more quickly. From the lateral pharyngeal space, the injections often passed into Space 3, from where they sometimes spread to the superior mediastinum, or broke through the alar fascia and extended down Space 4 to the posterior mediastinum. This is the pathway taken by infection from the floor of the mouth in Ludwig's angina and is practically a reversal in direction of that taken by retropharyngeal abscess. The latter, therefore, by extension to the submandibular space, may resemble Ludwig's angina in the later stages, although the origin and early spread of the two conditions are entirely different. (Figs. 3, 5 and 9)

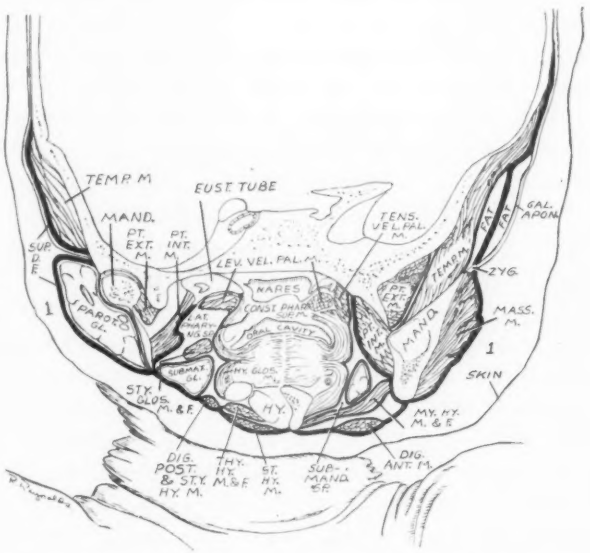

FIG. 9.—Frontal section of full term fetus through base of tongue and posterior nares. Anterior view.

ETIOLOGY AND PATHWAYS OF SPREAD.—Retropharyngeal abscess may be acute or chronic. The latter is usually due to tuberculous caries of the cervical vertebrae, is apt to be confined posterior to the prevertebral fascia in Space 5, and usually gravitates to lower levels along muscles taking origin from the vertebral bodies (psoas abscess). It is most common in adults. (Fig. 1)

The acute variety, on the other hand, is most common in children, especially under the age of three years. The portal of entry is practically always the nose, throat or middle ear. The infection passes through the pharyngeal wall by continuity or more commonly by lymphatics to the retropharyngeal and lateral pharyngeal nodes. Perhaps the greater number of retropharyngeal lymph nodes present under the age of three or four years accounts for the greater incidence in that age period (Morse, 1903; Meierhof, 1905; Alexander

and Montague, 1913). The possibility of spread through the veins from the pharynx to the internal jugular veins with thrombosis and secondary extension to the retro- and lateral pharyngeal spaces must also be kept in mind.

Infection, extending through the lateral pharyngeal wall opposite the palatine tonsil either by direct continuity or by lymphatics, leads to direct infection of the lateral pharyngeal space. On the other hand, infection from the posterior pharyngeal wall, nose (including the accessory sinuses) or middle ear may reach the retropharyngeal space by continuity or lymphatic extension. As shown above, this infection may be in the visceral space, Space 3 or Space 4. As Space 3 and the lateral pharyngeal space are continuous, there may be extension from one to the other. On the other hand, extension may occur from Space 3 to the superior mediastinum or through the alar fascia to Space 4 and thus to the posterior mediastinum. It is because of the possibility of such extension that retropharyngeal and lateral pharyngeal abscesses are so serious. (Figs. 1 to 9)

The causative organisms are usually the common pyogens. Koplik (1896) found the Streptococcus in all his cases. The Staphylococcus and pneumococcus have also been reported as causative agents. Bokay (Morse, 1903) reported a case due to the tubercle bacillus. These organisms get into the retro- and lateral pharyngeal spaces by continuity, lymphatics or veins —either through inflammation of or trauma to (foreign bodies, operative trauma) the mucous membrane of the throat, pharynx, nose, accessory sinuses or middle ear.

Clinical Picture: *Acute Retropharyngeal Abscess.*—The patient, as stated before, is usually a child (especially under three years), although adults are not immune (Allen, 1881; Goodale, 1901). The onset is usually sudden. Following a nasopharyngitis, the patient develops chills and fever (103° to 105° F.). There is usually stiffness of the neck muscles and the head may be in opisthotonos. The throat is sore, the pain being aggravated by swallowing, which is difficult. The voice assumes a nasal twang and thirst is marked. Dyspnea and cyanosis occur as the swelling increases. In young children, convulsions may ensue.

On examination of the throat, a definite bulging of the posterior pharyngeal wall is noted. This is usually a little to one side of the midline due to the fact that the retropharyngeal lymph nodes, which are usually involved, are distributed in two chains, one on either side of the midline (Morse, 1903; Meierhof, 1905; Waugh, 1906). Since such swellings are common without suppuration in ordinary lymphatic drainage from the nose, sinuses and nasopharynx, it is necessary to palpate the mass with the fingers to determine the presence of fluctuation and, in doubtful cases, even to needle the mass to prove the presence of pus. Extension of the process to the superior or posterior mediastinum is indicated by chest pain, dyspnea, persistence or recurrence of fever and roentgenographic evidence of mediastinitis.

Lateral Pharyngeal Abscess.—This may be secondary to a retropharyngeal abscess, or abscess in the parotid, masticator, or submandibular (Ludwig's

angina) spaces; or it may be primary due to extension by continuity, lymphatics or veins from the tonsil, lateral wall of the pharynx, nose or middle ear. It may, therefore, be preceded or accompanied by symptoms of retropharyngeal abscess, parotitis or Ludwig's angina. On the other hand, the first localization may be in the lateral pharyngeal space, in which case there is sudden onset of severe pain and tenderness just below the angle of the jaw and over the greater cornu of the hyoid bone. There is considerable pain on swallowing and salivation is apt to be excessive. An external swelling below the angle of the jaw is usually apparent by the second or third day and, internally, there is a bulging of the lateral pharyngeal wall, especially posterior and inferior to the palatine tonsil. Chills and fever are usually present. However, chills do not necessarily mean thrombosis of veins unless they persist after adequate drainage of the space involved. The voice and respirations are not affected unless the swelling becomes very large or is associated with retropharyngeal abscess. It is obvious that in the later stages, retropharyngeal abscess, lateral pharyngeal abscess and Ludwig's angina may closely resemble each other, although the origin of each is quite different. (Figs. 3, 4, 5 and 9)

Chronic Retropharyngeal Abscess.—As stated above, this is usually due to tuberculous caries of the cervical vertebrae and is, therefore, accompanied by other signs of that disease such as spinal deformity, spasm of the muscles of the back of the neck and associated cold abscesses gravitating to lower levels (psoas abscess). Roentgenographic evidence of caries of the cervical vertebrae confirms the diagnosis. Since the vertebral bodies are in the midline, this abscess is apt to cause forward bulging of the posterior wall of the pharynx in the midline, in contrast to the condition in acute retropharyngeal abscess. (Figs. 1 to 9)

TREATMENT.—Early and adequate drainage is essential. There is some difference of opinion as to whether drainage should be internally through the posterior pharyngeal wall or externally through the neck. There are many reports of successful drainages through the mouth (Allin, 1851; Smith, 1879; Allen, 1881; Agnew, 1882; McCoy, 1882; Sands, 1882; de Blois, 1885; Tiely, 1891 and 1892; Moore, 1893; Berg, 1894; Wharton, 1894; Koplik, 1896; Evans, 1897; Goodale, 1901; Travers, 1902; Morse, 1903; Meierhof, 1905; Holmes, 1907; Sheedy, 1912; Alexander and Montague, 1913; McKenzie, 1915). The objections to this method are the danger of aspiration of pus into the lungs causing suffocation or secondary abscess, the possibility of secondary infection from the throat, and the tendency of internal incisions to close, making reoperation sometimes necessary. On the other hand, the simplicity of the procedure in comparison with the external approach favors its use. Furthermore, by quickly inverting the child after the incision, the danger of aspiration can be largely avoided. (Figs. 1, 3 and 5)

External drainage was first performed by Chiene (1877), who made an incision along the posterior border of the sternocleidomastoid muscle and reached the abscess by dissecting behind the carotid sheath. Similar operations were performed by Cheyne (1881), and Hawkins and Ambler (1889). On

the other hand, Burckhardt (1888) described and employed an approach anterior to the sternocleidomastoid muscle similar to the incisions described later by Dean (1919), Kanavel (1922) and Furstenberg (1929). Mosher (1929) advised external drainage through a "T" incision below the angle of the jaw in front of the sternocleidomastoid muscle, the submaxillary salivary gland being displaced and the dissection being carried along the carotid artery until the focus is reached. This incision is especially applicable to primary and secondary involvement of the lateral pharyngeal or pharyngomaxillary space. Dean's incision is made between the hyoid bone and the cricoid cartilage along the anterior border of the sternocleidomastoid muscle, and the dissection passes between the carotid sheath and the thyroid gland. This opens Space 3 and drains any collections in this space. By plunging through the alar fascia with the finger, Space 4 is entered, and collections deeper in the retropharyngeal space and posterior mediastinum are drained. By going still deeper, through the prevertebral fasciae, Space 5 collections (due to caries of the vertebrae) may be also drained through this approach. Furstenberg's incision for cervical mediastinotomy is similarly placed but extends inferiorly to the suprasternal notch. (Figs. 2, 6 and 7)

It seems logical to drain small localized acute retropharyngeal abscesses without external swelling through the mouth, with proper precautions to prevent aspiration into the lungs. On the other hand, lateral pharyngeal collections, whether primary or secondary, with tumefaction externally at the angle of the jaw, are best drained by Mosher's or similar external approach. This will probably also take care of any associated retropharygeal abscess. Cold abscesses should certainly be drained externally by the method of Dean in order to prevent secondary infection from the throat. Such incisions may even be closed tight after evacuating the pus (Kanavel, 1929).

Mediastinotomy is indicated at the first sign of spread beyond the retro- or lateral pharyngeal spaces toward the superior or posterior mediastinum. There are in general two methods of approach: The collar (cervical) mediastinotomy of Lürmann (1876), Obalinski (1896), Cavazzani (1898), Ziembiecki (1898), Heidenhain (1899), Rasumowski (1900), von Hacker (1901), Guadiani (1916), Lerche (1921 and 1924), and Furstenberg (1929); and the dorsal (thoracic) mediastinotomy, first described by Nasiloff (1888). The collar drainage has already been described according to the technic of Dean and Furstenberg. This method is especially applicable to collections in the superior mediastinum (Space 3) and in the posterior mediastinum (Space 4) above the fourth thoracic vertebra (Figs. 2, 6 and 7). Dorsal mediastinotomy is especially indicated in collections in the posterior mediastinum below the fourth thoracic vertebra and as a secondary operation after collar mediastinotomy (Fig. 8). Various technics of dorsal mediastinotomy have been described by Quenu and Hartmann (1891), Bryant (1895), Heidenhain (1899), Enderlen (1901), and Lilienthal (1923). These vary chiefly in the location of the incision in relation to the vertebral spines. The reader is referred to these authors for details and procedure.

CASE REPORTS

Case 1.—University Hospital No. 42968: D. F., male, age 15 months, entered the University Hospital complaining of sore throat and difficulty in swallowing. Two weeks previously, he had contracted an acute respiratory infection and the cervical lymph nodes became enlarged. External cold packs were applied and seemed to localize the infection on the inside, behind the pharyngeal wall. Examination showed an infant of stated age with temperature of 101° F., pulse 150, respirations 32; apparently in considerable discomfort. The throat showed a bulging of the posterior pharyngeal wall a little to the right of the midline. Definite fluctuation could be appreciated upon digital examination. *Diagnosis:* Retropharyngeal abscess resulting from adenitis and paradenitis of the retropharyngeal lymph nodes, which in turn were infected from the nose and nasopharynx.

Treatment.—The abscess was incised through the posterior pharyngeal wall and the wound spread with a hemostat, according to the method of Hilton, on the day of entrance. Considerable thick, yellow pus was obtained which was permitted to drain out, with the child's head lowered to prevent aspiration. Uneventful convalescence. Patient was dismissed five days after entrance to the hospital.

COMMENT.—This is a case of typical retropharyngeal abscess secondary to adenitis and paradenitis of the retropharyngeal lymph nodes, following lymphatic extension from the nasopharynx. The retropharyngeal abscess probably occupied Space 3, and was also localized by an inflammatory wall. There was, therefore, very little tendency to extend laterally and inferiorly, and this probably explains the good results from simple internal drainage.

Case 2.—University Hospital No. 23976: N. F., female, age seven months, was brought to the University Hospital because of difficulty in breathing. She had been well until about seven weeks previous to entrance, when she contracted a sore throat and later a discharging ear. The posterior cervical nodes became enlarged, and were later incised. During the week previous to entrance, the parents noticed difficulty in her breathing, which had become worse during the last 24 hours. The patient had lost six pounds during this period. Examination showed a very pale, emaciated child with a temperature of 101° F. She was breathing with marked difficulty. The cervical nodes were enlarged, a soft, fluctuating group being present on the right. The posterior pharyngeal wall, a little to the right of the midline, was bulging, and fluctuated. *Diagnosis:* Retropharyngeal abscess. Suppurating cervical lymph nodes.

Treatment.—An internal incision through the posterior pharyngeal wall was made without anesthesia. Several ounces of thick pus were evacuated and the patient's head was lowered to prevent aspiration. The fluctuating cervical nodes were incised and drained. The child improved gradually and was dismissed from the hospital three weeks after operation.

COMMENT.—This presents another case of retropharyngeal abscess in an infant involving chiefly Space 3, and localizing in the posterior pharyngeal region. There was also primary and secondary lymphatic drainage from the nasopharynx to the pendent group of lymph nodes which suppurated and required separate incision.

Case 3.—University Hospital No. 51689: W. H., male, age two months, was brought to the University Hospital because of difficulty in breathing, of about six hours duration. The baby had been poorly nourished since birth, but had had no serious illness until one week before entrance, when a rounded swelling the size of a cherry was first noticed on the left side, a little below and posterior to the angle of the jaw. The swelling had increased considerably. About six hours before entrance, the baby had developed difficulty in

breathing, which had become progressively worse. Examination showed a poorly nourished child apparently in severe distress. Temperature, 100° F. There was a marked nasal and postnasal discharge. The cervical nodes were enlarged, with a large, hard swelling below the angle of the jaw on the left. The posterior pharyngeal wall was bulging, especially a little to the left of the midline. This swelling fluctuated. Both ear drums were dull, thick and red. *Diagnosis:* Postnasal discharge. Bilateral otitis media. Cervical adenitis. Retropharyngeal abscess.

Treatment.—The retropharyngeal abscess was incised through the mouth, with evacuation of thick pus. The head was lowered to prevent aspiration. A double paracentesis was performed; a bilateral mastoidectomy was, however, necessary a week later.

Postoperative Course.—The baby apparently recovered from the retropharyngeal abscess and mastoid operations, but died two weeks after entrance from malnutrition.

COMMENT.—The retropharyngeal abscess in this case may have been due to lymphatic drainage from either the nasopharynx or middle ear. Drainage of the retropharyngeal abscess and ears was apparently early and adequate, but the child succumbed because of malnutrition.

Case 4.—University Hospital No. 42267: D. B., male, age 33, entered the University Hospital complaining of sore throat and difficulty in swallowing. About two weeks previously he had developed the "flu" and sore throat. About five days before admission, his throat had become very sore and he was not able to swallow or talk. He was unable to sleep because of pain on involuntary swallowing, and was unable to take fluids or food. Examination showed a very emaciated young man, unable to swallow or talk above a whisper. Temperature was 100° F., pulse 60, respirations 18. Local examination revealed a large, red swelling of the posterior pharyngeal wall, pushing the tonsils forward and pressing against the uvula. *Diagnosis:* Retropharyngeal abscess.

Progress.—The abscess ruptured spontaneously and the patient made an uneventful recovery without surgery.

COMMENT.—This is a case of retropharyngeal abscess in the adult. Although it is possible that the infection passed directly through the posterior pharyngeal wall, it is more likely that the extension was by the lymphatics which, though less abundant than in early childhood, are still present in the adult. The abscess was no doubt localized in Space 3, thus making the spontaneous rupture possible.

Case 5.—University Hospital No. 57412: M. G., female, age 63, entered the University Hospital complaining of pain and fulness in the neck at the level of the cricoid cartilage. The night before, while eating supper, she had a sudden severe pain in her throat which later moved to the epigastrium and was referred to the back. Laryngoscopic examination was negative and esophagoscopy revealed only a red, edematous mucosa. Roentgenologic examination of the esophagus was negative and study of the chest revealed accentuation of the vascular markings with an area of calcification lateral to the right hilum. Soon after entrance, she experienced considerable difficulty in swallowing. Two days later she became suddenly cyanotic and expired. Autopsy revealed a retropharyngeal abscess and posterior mediastinitis.

COMMENT.—This case is a good example of retropharyngeal abscess involving Space 4, due to trauma of the pharyngeal wall rather than to lymphatic spread from the ear, nose or throat. There was very little tendency to localize in the head and cervical region (by inflammatory reaction) but, instead, the abscess gravitated to the posterior mediastinum which is directly

continuous with Space 4. The mediastinitis was not recognized antemortem. Possibly if it had been, and drainage had been instituted, the fatal outcome might have been averted.

Case 6.—University Hospital No. 41614: C. A., male, age seven, was admitted to the University Hospital with a history of having swallowed a tack one week previously. The tack was recovered in his stool six days later. His throat became very sore; he was unable to swallow, and his voice became nasal in type. Examination showed a thin, poorly nourished boy having some difficulty in breathing, swallowing and talking. The throat was red. The posterior cervical lymph nodes were palpable and the anterior neck was swollen from the mastoid to the submaxillary regions. Roentgenologic examination showed encysted fluid or pus behind the posterior pharyngeal wall at the level of the glottis. Examination of the throat showed a bulging of the posterior pharyngeal wall which compressed the epiglottis, and interfered with respiration and deglutition. *Diagnosis:* Retropharyngeal abscess following trauma.

Treatment.—On the eve of entrance, the child suddenly became cyanotic and more dyspneic, making a tracheotomy necessary. A little gas escaped from the sides of the larynx and trachea. Following this, the posterior pharyngeal wall was incised through the mouth and about two ounces of thick, yellow pus escaped. Patient made an uneventful convalescence and was discharged six days after entrance.

COMMENT.—This is another example of retropharyngeal abscess due to trauma of the posterior pharyngeal wall. In this case, however, the tack apparently penetrated only the pharyngeal wall and visceral fascia, thus infecting Space 3. There was some inferior and lateral extension in Space 3, but most of the infection remained localized in the oral region and was successfully drained through the mouth after a preliminary tracheotomy which included drainage of Space 3 on either side of the trachea and esophagus.

Case 7.—University Hospital No. 18600: C. S., male, age 28, entered the University Hospital complaining of pain in his throat, difficulty in swallowing, and pain in the neck. While eating dinner three days previously, he had experienced a sudden pain in his throat as though the bolus were lodged there. Since then there had been severe pain, especially on trying to swallow, and he had been unable to take anything except liquids. Twenty-four hours before entrance to the hospital, his neck had become swollen and tender. Examination showed the neck tense, red, and tender from the thyroid cartilage to the sternum. The throat was red. Roentgenologic examination showed a shadow of a foreign body anterior to the sixth cervical vertebra, possibly at the entrance of the esophagus. A directoscope was passed and a large bone was removed from the esophageal wall. The temperature on entrance was 102.4° F., pulse 104. *Diagnosis:* Foreign body. Retropharyngeal abscess extending through the neck to the superior mediastinum.

Subsequent Course and Treatment.—Patient carried a septic temperature (101 to 104.2° F.), rapid pulse (120 to 140), and rapid respirations (32 to 45). He had considerable difficulty in breathing. On the third day the neck was incised anterior to the left sternocleidomastoid muscle and considerable pus evacuated from around the thyroid gland and esophagus (Space 3). At this time the blood culture was positive for Staphylococcus and Streptococcus. The patient continued to run a septic temperature and in spite of supportive measures died rather suddenly.

Autopsy revealed a retropharyngeal abscess (traumatic), fascial space abscess of the neck (Space 3) and superior mediastinitis.

COMMENT.—Again we see a case of retropharyngeal abscess in Space 3, due to trauma of the pharyngeal wall. In this case, the foreign body entered

rather low (at the junction of the pharynx and esophagus, about the level of the sixth cervical vertebra) and the infection passed laterally and inferiorly, finally reaching the superior mediastinum. Cervical mediastinotomy was performed perhaps a little late, but the septicemia present would probably have led to fatal outcome even with earlier surgical intervention.

Case 8.—University Hospital No. 20411: A. H., female, age 34, entered the University Hospital complaining of sore throat, inability to swallow, and pain in the left ear. Two weeks previously, she had taken cold, her throat had become sore, and she had developed an earache. A few days before entrance, her neck had become swollen on the outside. Examination showed an obese woman, apparently in severe pain. There was a swelling on the left side of the neck extending from the ear almost to the clavicle. It was hard and indurated. The throat was red and there was a definite bulging of the lateral pharyngeal wall on the left side. There was a small amount of pus coming from an opening just above the tonsil. Temperature 103.5° F., pulse 130. *Diagnosis:* Lateral pharyngeal abscess.

Treatment.—The day after admission, an incision was made anterior to the left sternocleidomastoid muscle and a small amount of thick pus was obtained. The temperature remained high (106° F.), pulse rapid and respirations difficult. The patient gradually became weaker and expired two days after admission. No autopsy.

COMMENT.—This case is an example of lateral pharyngeal abscess resulting from direct extension through the lateral pharyngeal wall or lymphatic extension from the throat or middle ear. Extension through the venous system is also a possibility. Unfortunately no autopsy was obtained, but the clinical course suggests that the infection extended from the lateral pharyngeal space to Space 3 by continuity. From Space 3 the infection, no doubt, spread inferiorly through the neck to the superior mediastinum. It is also likely that the abscess ruptured through the alar fascia to enter Space 4, and extended inferiorly into the posterior mediastinum. The cervical incision was obviously inadequate to properly drain the spaces involved.

Case 9.—University Hospital No. 175: H. H., male, age 32, entered the University Hospital complaining of sore throat, swelling of the neck, pain in the chest, dyspnea, chills, and fever. About two weeks before entrance, patient had "La grippe" accompanied by sore throat. About one week later, his neck began to swell, and he experienced difficulty in swallowing and talking. A few days before entrance, he had had a severe chill lasting an hour. This was followed by pain in the center of the chest and difficulty in breathing, symptoms which were present on entrance. Examination showed a very ill man. Temperature 104.4° F., pulse 124, respirations 36. The throat was red but not bulging. The neck was swollen and indurated on both sides from the mandible to the sternum and clavicles. Dulness and moist râles were present over the lower right lobe of the lung. *Diagnosis:* Deep neck abscess and right empyema.

Subsequent Course and Treatment.—Three days after entrance, the neck was drained by bilateral incisions and much pus obtained. The next day, a right empyema was drained through an intercostal incision. Patient did poorly and died the following morning.

Autopsy.—Infection of the deep spaces of the neck secondary to retropharyngeal abscess and leading to posterior mediastinitis. Secondary right empyema by extension of infection from the posterior mediastinum.

COMMENT.—This patient no doubt had a severe nasopharyngitis during his attack of "La grippe" two weeks before entrance. The infection then spread by the lymphatics to the retropharyngeal nodes, causing an adenitis and paradenitis of these nodes, and resulting in a retropharyngeal abscess. The latter, however, did not remain localized in the retropharyngeal space (therefore, there was no bulging of the posterior pharyngeal wall), but extended inferiorly in Space 4, producing a posterior mediastinitis. The swelling in the neck was no doubt due to accumulation of pus in Space 4, but there may also have been some inferior extension in Space 3, and an adenitis of the pendent group of lymph nodes by drainage from the nose and throat. The incisions in the neck were late and inadequate, and no attempt was made to drain the mediastinum, although the secondary empyema on the right side was drained. It is conceivable that earlier and more adequate drainage might have resulted in a different outcome. This, in turn, would have required an earlier and more complete diagnosis based upon anatomic grounds.

CONCLUSIONS

(1) Acute retropharyngeal and lateral pharyngeal abscesses are secondary to infection of the nose, throat or middle ear. They are more common in young children under the age of three years. This may be due to the greater abundance of lymphatics in that age-period. The common pyogens are usually the responsible organisms.

(2) The infection reaches these spaces by direct continuity, venous or lymphatic drainage, the latter being most common except where trauma is a factor, in which case the spread is by direct implantation.

(3) Acute retropharyngeal abscess may involve the space between the pharyngeal wall and the visceral fascia (visceral space), the space between the visceral and alar fasciae (Space 3) or the space between the alar and prevertebral fasciae (Space 4).

(4) Infection in the visceral space is apt to remain localized at the site of origin. Infection in Space 3 may remain localized at the site of origin, but may also spread inferiorly and laterally through the neck to the superior mediastinum. It may also break through the alar fascia and reach Space 4. Infection in Space 4 ("danger space") is apt to gravitate through the neck into the posterior mediastinum.

(5) The lateral pharyngeal space is directly continuous with Space 3. It may be primarily infected from the lateral pharyngeal wall or may be secondarily infected from Space 3, the parotid space, masticator space or submandibular space. Vice versa, primary infection within the lateral pharyngeal space may spread secondarily into those spaces. Infection in the lateral pharyngeal space extending into the submandibular space may resemble Ludwig's angina in the later stages.

(6) Chronic retropharyngeal abscess is practically always due to tuberculous caries of the cervical vertebrae. It is usually confined to Space 5 behind

the prevertebral fascia, and usually gravitates to lower levels along muscles taking origin from the vertebral column (psoas abscess). It may, however, remain localized in the cervical region, in which case it may rupture through the alar fascia and enter "danger space" 4. It is more common in adults.

(7) The clinical picture of pain, difficulty in swallowing and speaking, chills and fever, internal bulging of the pharyngeal wall, and external swelling of the neck should make early diagnosis possible.

(8) The treatment is chiefly surgical—early and adequate drainage. This may be internal through the mouth for cases confined to the posterior pharyngeal region (visceral space and Space 3). External incision is necessary for collections in the lateral pharyngeal space or inferior extensions in Spaces 3 or 4. The "T" incision of Mosher with reflection of the submaxillary salivary gland is especially applicable for collections in the lateral pharyngeal space. Spaces 3 and 4, including collections in the superior mediastinum and posterior mediastinum above the fourth thoracic vertebra, may be effectively drained by cervical incision anterior to the sternocleidomastoid muscle (collar mediastinotomy). Collections in the posterior mediastinum below the level of the fourth thoracic vertebra demand posterior thoracic drainage (dorsal mediastinotomy).

NOTE:—The illustrations are reproduced through the courtesy of the *American Journal of Anatomy*.

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PRIMARY LYMPHOSARCOMA OF THE STOMACH

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PRIMARY lymphosarcoma of the stomach is not a common surgical disease. They comprise from 40 to 50 per cent of all gastric sarcomata, which, in themselves, form but 1 to 2 per cent of all gastric neoplasms. However, with the increase of surgical procedures upon the stomach, it was felt of value to consider these lesions from a diagnostic and prognostic point of view; especially as it is improbable that any one surgeon will deal with any large number of cases, whereby he may judge the value of a particular type of therapy.

No attempt will be made to clarify the perplexing problem of neoplastic and neoplastic-like lesions of the lymphoid system. Until a clearer conception of the histogenesis of these lesions is available, disagreement in both terminology and classification is inevitable. An effort has been made here to include only those cases of lymphosarcoma that arise primarily from the lymphoid tissue of the stomach and are not a part of like changes taking place simultaneously in similar tissue in other portions of the body. Cases with insufficient data and those that were not clear-cut histologically have been omitted from the statistics. However, for the sake of completeness, a number of these closely related cases* have been included in the bibliography.

Five proven cases were found in the files of Presbyterian Hospital. These will be reported in detail, as they seem significant in calling attention to variations in the natural history of the disease—particularly in viewing the outcome in relation to the treatment given.

In 1871, Cruveilhier reported the first case of gastric lymphosarcoma (quoted from Forni). By 1914, Forni, in collecting 200 cases of gastric sarcoma, found 33 lymphosarcomata. He, for the first time, emphasized the necessity of a histopathologic classification of these sarcomata, to supplant the purely morphologic, endogastric and exogastric, division. D'Aunoy and Zoeller, in 1929, reviewed the literature and brought Forni's series up to date. Since then, except for case reports and small series from individual clinics, there has been no extensive review of the literature. The data presented here will be based on 152 cases of primary lymphosarcoma collected from the literature up to 1937, including five cases reported for the first† time from this hospital.

Etiology.—The average age of the patients in this series was 44.3 years, which closely approximates the figures quoted by most authors. The youngest

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* References for these cases are marked with an asterisk in the bibliography.

† Case 5 was presented, in 1933, by Dr. David Bull before a meeting of the New York Surgical Society.

case was three years and eight months old. He recovered after subtotal resection. The oldest patient was 80 years of age, on whom the diagnosis was made at postmortem. It will be seen that the average age of these patients is about 10 years younger than of those with carcinoma. Furthermore, there is a considerably greater proportion in the first four decades of life than would be found in a similar carcinoma series, 20 of 114 cases being less than 40 years of age.

The sex is known in 124 cases. There are 78 males and 46 females, a ratio of 1.6 to 1—a less marked male preponderance than the 3 to 1 usually quoted for carcinoma.

As with most neoplasms, there has been considerable speculation regarding the etiology of these tumors. Perhaps the most prominent "exciting cause" has been attributed to trauma. This causative factor was made much of by many of the early authors. However, although there are striking examples of coincidental injuries preceding discovery of the lesion, critical examination of the data is far from conclusive.

Peptic ulcer also has been incriminated as a precursor of these tumors. No such relationship has been borne out on histologic examination, even though the gross appearance at operation is very suggestive of gastric ulcer.

Although it has often been suggested that benign lesions of the stomach may degenerate into malignant ones—polyps to carcinoma or myoma to sarcoma —there is no evidence that lymphosarcoma arises from such growths.

Some pathologists feel that tuberculous lesions of the stomach may be the irritative and initiating factor—particularly in the presence of aberrant, undifferentiated cells in the submucosa.

Pathology.—Primary lymphosarcoma of the stomach can arise from any lymphatic tissue in the organ. It is probable, however, that the lesion begins most often in a lymph follicle in the submucosa. From this point of origin, it penetrates along the tissue spaces and infiltrates the various layers. The muscle layers particularly are involved, each band of muscle being separated by large masses of tumor cells. The submucosa is enormously thickened, and this explains the giant rugae that are sometimes seen in a roentgenogram. The mucosa, not being the site of the original growth, does not show the early characteristic ulceration of carcinoma. However, later ulceration does take place, and "characteristic" ulcer niches and craters may develop. These tend to be more shallow than in carcinoma and frequently are multiple. Involvement of the serosa is usually a late manifestation but often assumes great proportions. Due perhaps to compromise of the blood supply by diffuse infiltration of all the layers, necrosis is frequent, and for this reason perforation is not uncommon.

Grossly, the lesions may be divided into four types (Pack and McNeer, 1935): (I) A single bulky polypoid growth well demarcated from the normal stomach; (II) solitary or multiple ulcers with surrounding infiltration; (III) multiple nodular tumors in the submucosa; (IV) diffuse thickening of the wall. This last type strongly resembles the fibrocarcinoma designated as

"linitis plastica"—except that the stomach is not contracted and large mucosal folds are frequently present. Unfortunately, the largest number are of Types II and IV. As the well demarcated growths are comparatively infrequent, lymphosarcoma does not share the advantages that some other of the sarcomas have over carcinoma from a surgical standpoint. The large pedunculated growths of the exogastric type found in other types of sarcoma are not found with lymphosarcoma.

Gross diagnosis is not always possible. The lesion is most frequently confused with carcinoma. Some cases have been treated operatively on the assumption that a peptic ulcer was the basis of the pathology. Gastric syphilis may also be confusing, but the frequent presence of large, isolated, succulent perigastric nodes may serve to differentiate this condition.

The curvatures are usually considered as being the commonest site of origin. Actual involvement of the orifices is unusual, although the lesions frequently extend to involve both the anterior and the posterior walls. Even though the prepyloric region is often involved, pyloric stenosis is an unusual finding. The location of the lesion is known in 74 of the cases collected. Fifty-five of the cases involved one or both of the curvatures in the lower half of the stomach. Only six cases had pyloric stenosis. Three patients had lesions high in the cardia, one of whom complained of dysphagia. Ten cases were of the diffuse infiltration "linitis plastica" type.

These tumors may simulate at least two of the cell types found in lymphoid tissue—the small lymphocytes and the reticulum cells, which lend their names to the two types of lymphosarcoma encountered. Whether or not the parent cells of the follicles can give rise to a neoplasm has not been definitely established. Undoubtedly, these three cell types bear a close histogenetic relation to one another. Just what this relationship is, is not clear, as is demonstrated by the apparent change in cell type in some cases of giant follicular hyperplasia as they are followed throughout their course. However, in primary lymphosarcoma of the stomach a division into two types, lymphocytic cell and reticulum cell, seems adequate, and each type has its characteristic histology. In the lymphocytic type the cells resemble atypical lymphocytes in size and in the relation of nucleus to cytoplasm, and have deep staining hyperchromatic nuclei. At times there may be some variation in size, and cells nearly as large as mononuclear cells with a somewhat different nuclear arrangement are noted. Thus, the impression may be given of there being two cell types present. However, the small round cell resembling a lymphocyte is the predominant and distinctive one. Mitoses are frequent and often atypical. Multinucleated and "giant" cells are occasionally noted. Polymorphonuclear cells may be found scattered through the tumor tissue, but surrounding fibrosis and inflammatory reaction is usually not present, even though areas of liquefaction and necrosis are frequently found in the tumor.

The cells have not the definite connective tissue stroma that is the framework of a carcinoma, and even with special stains, only a fine, fibrous reticulum is demonstrated as the supporting structure. It is this character of the stroma

that accounts for absence of "shrinking" of the stomach and narrowing of the lumen with subsequent stenosis.

All of the layers of the stomach wall may be entirely replaced by the tumor. Large areas may show no intact mucosa and only tiny remnants of glands will be found lying among masses of tumor cells. The muscularis mucosae is usually intact and is involved only in the most advanced cases.

In the reticulum cell type, infiltration of the layers may be present in a similar manner, but the predominant cells are cuboidal to polyhedral in shape, the nuclei hyperchromatic, and a large, well-defined cytoplasm is present. These cells may vary in size and shape in various parts of the tumor and are frequently bizarre in appearance. In some cases, a slightly more prominent fibrous framework is present. Usually the histology is just as distinctive as in the lymphocytic cell type. However, to differentiate some of these lesions from highly undifferentiated anaplastic carcinomata is sometimes very difficult, and the correct diagnosis can be inferred only from the subsequent course of the patient.

The perigastric and adjacent retroperitoneal nodes are the most frequent sites of extension. They are smooth and large and are relatively soft in contrast to the hard, more discrete metastatic nodes of carcinoma. Often they are matted together so that with involved omentum and areolar tissue, they make a mass larger than the original tumor itself. On section, the nodes are gray to pink and their structure appears completely lost. Metastases to liver, spleen and pancreas are found, but large nodules are infrequent. In Case 1, reported herewith, at autopsy, metastases were noted in perigastric, peripancreatic, aortic, iliac, mesenteric and cervical nodes, omentum, pancreas, both ovaries, both lungs, pleura, diaphragm and peritoneum.

Since sarcomata, in general, are considered to have exclusively blood stream metastases, considerable discussion has taken place concerning the mode of extension of these tumors. Certainly this type of metastasis does occur in lymphosarcoma. However, the primary lymph node metastases must be considered as occurring by direct extension or metastasis through the lymphatics to the adjacent nodes. Tumor cells actually infiltrating the lymphatics of the stomach have been demonstrated in several cases.

Clinical and Laboratory Data.—Careful evaluation of the clinical and laboratory findings reveals no single pathognomonic sign in the individual case. However, when taken as a group there are some suggestive points of differentiation. Pain of the ulcer type is a constant and often an outstanding symptom. "Dyspepsia" and anorexia are prominent findings, but a long history of anorexia with advanced emaciation is unusual. Some weight loss is the rule. Vomiting, if present, is usually not of the obstructive type, a finding which is easily explainable by the infrequent occurrence of pyloric stenosis. Hematemesis is not common, being noteworthy in but 12 cases in the present series. Straus (1925) believes it to be diagnostically significant in the presence of a nonobstructing tumor in a young patient. Melena is a frequent finding and occult blood was always found when a test was made for it. Perforation

of these lesions is considerably more frequent than with carcinoma. A palpable mass is present in almost two-thirds of the cases and is frequently quite large, in striking contrast to the absence of advanced emaciation in the patient.

There is no general agreement concerning the presence or absence of free hydrochloric acid. Douglas (1920) states that in the presence of a gastric lesion, youth and free hydrochloric acid are the most important factors suggesting a diagnosis of lymphosarcoma. In 17 of the 33 cases, in which gastric analyses are reported, the free hydrochloric acid was normal or elevated. This is a higher proportion than would be expected in a similar carcinoma series.

Roentgenologic Examination.—The case of Balfour and McCann is the only* recorded case in which the diagnosis was made roentgenologically, preoperatively. There is a unanimity of opinion among most radiologists that there is no typical picture upon which to establish a positive diagnosis of lymphosarcoma. The lesion is most frequently mistaken for a carcinoma, and even in retrospect, the roentgenologic findings are often "typical" of carcinoma. It is also, at times, indistinguishable from peptic ulcer, particularly when a single "calloused" ulcer defect is noted in the prepyloric area on the lesser curvature.

If the history and clinical findings are taken into consideration, there are some suggestive points: two or more defects in separate portions of the stomach should arouse suspicion, when they do not appear to be consistent with polyposis. In the presence of a large palpable tumor, instead of narrowing of the pylorus as with carcinoma, there may even be widening of the lumen. Rarely, these lesions when arising in the cardia may show roentgenologic evidence of extragastric penetration through the diaphragm. This is not found with carcinoma. Exaggeration of the mucosal folds to form giant rugae is seen, but this is not in itself diagnostic, however, when they are present and a filling defect is noted in a stomach with pliable walls, one has what is probably the most "typical" picture of lymphosarcoma.

Gastroscopy.—Four cases have been observed through the gastroscope. None of these, however, was correctly diagnosed preoperatively. Schindler (1937) feels that the picture is sufficiently characteristic to enable him to make the diagnosis in the future.

Treatment.—Radical, subtotal gastrectomy followed by intensive deep radiotherapy has usually been considered the treatment of choice. Operation is contraindicated only in those patients who are obviously in the last stages of the disease. Even then some effort should be made to establish a histologic diagnosis. This point is emphasized because of the marked regression following radiation, sometimes seen, in patients who appear to have a far advanced gastric neoplasm. Zanetti's case (1935) appeared to be in excellent health and showed no roentgenologic evidence of disease, two years after presenting himself with an apparently hopelessly advanced lesion. Undoubtedly, a number of patients with lymphosarcoma have died with the diagnosis of carcinoma. Had the correct histologic diagnosis been established, it is reasonable to assume

* Case of Escudera, quoted by Gomez y Gomez (1931) and referred to by Bastiony (1935) was not available for study.

that a few of these might have received at least palliation. In very sick patients and where tissue examination is impossible a therapeutic trial with radiation seems justifiable.

The Pólya type of resection, with whatever modifications the surgeon is best acquainted, is well suited to the disease unless the situation or extent of the lesion requires complete gastrectomy. Since radiation stands as an effective subsequent means of treatment, resection should be performed if technically feasible, even if it appears questionable that all the local extension of the disease can be completely removed. Palliative procedures, such as gastroenterostomy, are rarely indicated, since stenosis is quite unusual and because radiation is of more value.

In this series of 152 cases, celiotomy was performed in 118 patients. Seventy-six of these had subtotal gastrectomy performed, with 12 postoperative deaths—an operative mortality of 15.8 per cent. This 50 per cent resectability is much greater than carcinoma and the operative mortality somewhat less.

It is exceedingly important to administer the roentgenotherapy carefully. Due to the marked intolerance to radiation over the epigastrium, only relatively small amounts can be given under the most favorable circumstances. The exact site of the lesion, with the patient in the position he is to assume during treatment, should be determined by barium meal and the corresponding area delineated on the abdominal wall. This is essential in order to deliver the maximum radiation directly to the lesion. Nausea, anorexia and "burning" distress may be so marked as to preclude further therapy if it be poorly directed or if too large daily doses are delivered.

Scaled, fractional doses over a period of 25 to 35 days are considered the optimum plan of therapy. As Pack and McNeer (1935) recommend, the radiation is best delivered to the outlined lesion through three portals, left anterior, left posterior and left lateral. Between 50 and 100r. is given at each sitting, depending upon the tolerance of the individual patient. A total tumor dosage between 2,500-4,000r. is desirable. If marked improvement results, but the disease remains, demonstrable clinically or by gastro-intestinal series, a second and third series may be administered at intervals of from six to eight weeks or more. When the tumor seems to be susceptible and gross metastatic lesions are noted, these should also be radiated.

Radiation of hollow viscuses containing large ulcerating tumor masses always entails the real danger of gross hemorrhage. For this reason, Holmes (Cabot Case, 1934) endorses resection whenever possible before radiation. However, Pack and McNeer (1935), while acknowledging the danger, have not had this complication in treating a number of patients with irremovable lesions. The possibility of producing adrenal insufficiency with radiation in this area has been also noted, but it has been shown that this probably does not occur unless the gland is already the site of neoplastic infiltration.

Undoubtedly, radiation has secured remarkable results with regression of all signs of the growth for long periods—if not actual "cures." However, the

degree of radiosensitivity of the growth, apparently, is not predictable from the study of the pathologic material. Thus, a far advanced growth may react favorably for a number of years to what is generally considered inadequate treatment, while an apparently favorable one will rapidly come to fatal termination with excellent therapy. This suggests that these lesions have a life history independent of the type of therapy administered and what appears to be "curative" treatment may be only coincidental in the "natural" course of that particular neoplasm.

Results.—Including two cases from this hospital, 13 of the 152 cases were living and well 5 to 22 years after the diagnosis had been established. A brief synopsis of the essential data relevant to the 11 cases reviewed is appended.

No. 1.—Cheever, D. (1932): Female, age 52, had a segmental resection of middle third of stomach. Pathologic Report: Lymphocytic cell lymphosarcoma. Two roentgen ray treatments were given postoperatively. Living and well five years later.

No. 2.—Pack, G., McNeer, G. (1935), Case 5: Female, age 46, complained of pain and dysphagia. Bulky tumor involving pars media and cardia found at operation. Biopsy: Reticulum cell lymphosarcoma. With radium pack, 48,000 mg. hours was given at a distance of 15 cm., anteriorly and posteriorly to cross-fire the stomach. Living and well six years later.

No. 3.—Pack, G., McNeer, G. (1935), Case 7: Male, age 53, was operated upon by Dr. S. Harvey; had a segmental resection of the prepyloric area. No roentgen ray treatment. Pathologic Report: Lymphocytic cell lymphosarcoma. Living and well 7½ years later.

No. 4.—Collins, E., Carmody, M. (1937): Male, age 9, had a partial gastrectomy and posterior gastro-enterostomy. No roentgen ray treatment. Pathologic Report: Lymphocytic cell lymphosarcoma. Living and well 22 years later.

No. 5.—Falta, W. (1926): Male, age 55, had a subtotal gastrectomy and gastro-enterostomy. Line of resection, distally, went through what was considered a "peptic ulcer." Pathologic Report: Lymphosarcoma. Immediate intensive radium treatment. Five other treatments in next 24 months. Two "prophylactic" exposures to radium later. Living and well 6¾ years postoperatively.

No. 6.—Clar, K. (1935): Male, age 22, had a Bilroth II-Hoffmeister resection of the stomach. No roentgen ray treatment. Pathologic Report: Lymphocytic cell lymphosarcoma. Adjacent excised nodes showed only hyperplasia. Living and well seven years later.

No. 7.—Gunsett, A., Oberling, C. (1928): Male, age 48, had a prepyloric tumor penetrating through to pancreas with many metastatic nodes on lesser curvature. Biopsy and anterior gastro-enterostomy. Pathologic Report: "Pure" lymphosarcoma. Received 17 radiotherapy treatments in three weeks for a total of 26 hours. A total of 12,700 (French) r. given anteriorly, posteriorly and from both sides at a distance of 40 cm. through 1 Mm. of copper at 2.5 m.a. Living and well at five years. G. I. series negative for recurrence.

No. 8.—Weeden (1929), Gibson (1927): Male, age 34, had pain in epigastrium six months coming on one hour after eating. Weight loss 20 lbs. Operative Pathology: A mass size of palm of hand in posterior surface of stomach with enlarged nodes. Operation.—Distal one-third of stomach resected (Gibson pylorectomy). Pathologic Report: Lymphosarcoma. In excellent health nine years later.

No. 9.—Leriche, R., Irman, E., (1929): Male, age 43, had epigastric distress one year previously, at which time a G. I. series was negative. Recurrence of pain with weight loss and appearance of large mass in right epigastrium. Operative Pathology: A large tumor of the antrum with extension on lesser curvature. Operation.—Pólya resection with anterior gastro-enterostomy. Pathologic Report: Lymphosarcoma of stomach. Well for six years, when epigastric distress recurred. Roentgen ray suggested gastrojejunal ulcer. Operation.—Gastrotomy. No trace of original disease or ulcer. Discharged in good health six years and six months after operation for original disease.

No. 10.—Kaiser (1934): Female, age 51, had pain in left epigastrium. Weight loss 6 Kg. Hard mass beneath left costal margin. G. I. series showed tumor arising from greater curvature in upper third of stomach. Operation.—Biopsy only, as mass was too large to remove. Pathologic Report: Lymphocytic cell lymphosarcoma. Muscle is infiltrated but serosa is not involved. Patient received three roentgen ray treatments over a period of three months to a field 18x18 cm. The radiation was delivered by a 200 K.V. machine at 2.5 m.a. with 1.3 Mm. Cu. and 1.0 Mm. Al. filter. Between 70 and 77 per cent of the skin erythema dose was delivered to the tumor. G. I. series, in 1928 and again in 1929, were negative for persistence of disease. Patient is living and well eight years after biopsy.

No. 11.—Ruppert (1912), (Shopf): Female, age 57, had a complete gastrectomy for a diffuse infiltrating lesion. Pathologic Report: Typical infiltrating, primary endogastric lymphosarcoma. Living and well 14½ years later; with negative G. I. series. Small intestine was shown to have pouched out considerably and served as a temporary food reservoir.

RÉSUMÉ OF FIVE CASE HISTORIES FROM THE PRESBYTERIAN HOSPITAL, N. Y.

Case 1.—No. 222365: F. F., White, female, age 48, married, was admitted to the hospital April 16, 1934, complaining of swelling and distention of abdomen for three weeks. For years had been troubled with "indigestion" and gas, especially following fatty foods. For the last three weeks patient had noted abdominal swelling with feeling of pressure in epigastrium relieved by belching. She had had anorexia for last four days. Her bowel habit was regular and stools normal. She had lost a small amount of weight. Orthopnea had been noted for the past two days.

Physical Examination.—Revealed a poorly developed, chronically ill woman. Almond-sized hard node palpable in right supraclavicular fossa. No general node involvement. Lung signs were compatible with a right hydrothorax. The abdomen was greatly distended and tense. There was shifting dulness. Pitting edema in both legs. Hemoglobin

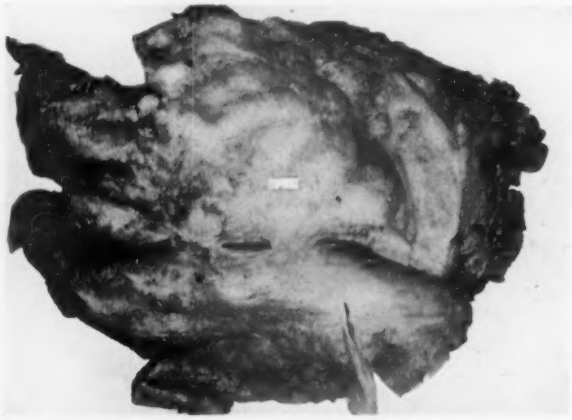

FIG. 1.—Case 1: The stomach specimen showing the smooth nonulcerated mucosa and the diffuse infiltration (linitis plastica) of practically the entire stomach.

80 per cent, R. B. C. 4,250,000, W. B. C. 7,850, polys 82, lymph. 9, monos. 7, eosinophils 1, basophils 1, urine negative, Wassermann negative.

Roentgenologic examination of chest showed right hydrothorax and some evidence of congestion on the left but no absolute evidence of metastases. A G. I. series demonstrated an extensive growth involving the entire lesser curvature—a "saddle growth" extending around posteriorly and anteriorly. Surgically she was felt to be a far advanced case of malignant disease with the stomach as primary focus, and the outlook hopeless. Temporary relief was obtained by paracentesis and thoracentesis. The fluid obtained contained cells about the size of large lymphocytes with dark ground glass cytoplasm and a round dark nucleus filling about half the cell. Some cells were in mitosis. She died suddenly just before discharge to a home for incurables. *Clinical Diagnosis:* Carcinoma of the stomach with metastases to peritoneum; pleural cavities.

Autopsy.—No. 11538: Dr. A. Longacre. *Pathologic Examination; Gross:* "The stomach wall is markedly thickened and firm throughout, except for a small area near the cardia. On the lesser curvature there are several large nodular masses (lymph nodes) covered with peritoneum which appear continuous in places with the gastric wall. On section they consist of white, granular tissue with areas of necrosis. On opening the stomach the mucosal surface is smooth, except for some areas where distinct ridges are present (Fig. 1). No ulceration is seen. On section the markedly thickened mucosa is seen infiltrated with grayish tissue which in places extends through the entire thickness of stomach. Gross evidence of metastases are seen in regional lymph nodes, pancreas, omentum and diaphragm and small foci in pleura, ovaries and cervical nodes."

Microscopic.—The mucosa, submucosa, muscularis and serosa are densely infiltrated with tumor cells. The cells are predominantly of two types—a round cell the size of a small lymphocyte with dense hyperchromatic nuclei surrounded by narrow zone of basophilic cytoplasm (Fig. 2). The other is about the size of a mononuclear with homogeneous, acidophilic cytoplasm. An oval nucleus is situated at a pole or along one side of the cell. Mitoses are frequent. A rare giant cell is seen. There is practically no stroma (Fig. 3). There are many capillaries. The mucosa shows some autolysis and replacement of some of the glandular elements with tumor. Muscularis mucosa is intact. Submucosa is markedly increased in width. The muscle fibers are separated by masses of tumor cells. The serosa is thickened by tumor infiltration.

Note by Dr. A. M. Pappenheimer: "A very characteristic lymphosarcoma of the stomach, which infiltrates the entire viscus as well as the regional lymph nodes, pancreas, omentum and diaphragm. There are small metastatic foci in the pleura and ovaries. The tumor cells are for the most part not highly atypical. Many of them closely resemble small lymphocytes, but there is an admixture of larger elements."

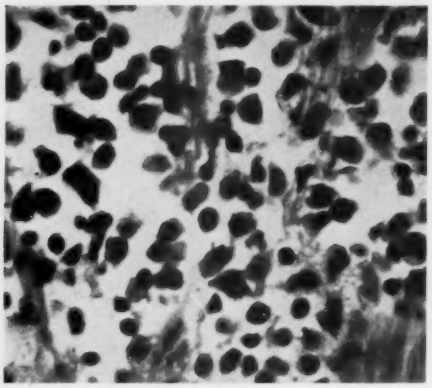

FIG. 2.—Case 1: Photomicrograph of a section of stomach. The predominant cells resemble small lymphocytes with hyperchromatic nuclei. There is an admixture of larger elements with eccentrically placed nuclei (×700).

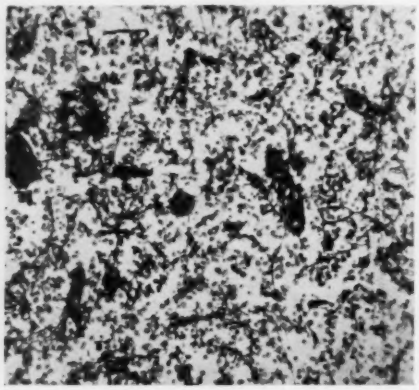

FIG. 3.—Case 1: Same section as Fig. 2, with reticulum stain clearly demonstrating the sparsity of stroma (×150).

This is an example of Type IV in Pack's and McNeer's classification, showing diffuse thickening of the wall, much like a "linitis plastica" lesion. Microscopically it is of the lymphocyte type of lymphosarcoma. Undoubtedly little could be done therapeutically for this particular patient, but it serves to demonstrate how easily a lymphosarcoma of the stomach may go on to fatal termination with a histologically unproven diagnosis of "typical carcinoma with metastases."

Case 2.—No. 230783: T. M., Negro, male, age 40, married, was admitted to the hospital June 18, 1935, complaining of abdominal pain for two months. He had always enjoyed general good health. "Blood tests" were said to be negative, but he had received some intramuscular injections. He had had crampy pain in the epigastrium for two months, usually coming on 15 minutes p. c. and relieved temporarily by food. He was told he had an ulcer one month before (no roentgen ray examination was done). Prescribed diet and powders had failed to relieve pain. Had vomited for first time four days before admission. Tarry stools were noted several times in the last six days.

Physical Examination.—Patient did not appear acutely ill. No superficial lymphadenopathy. The abdomen was not distended or tender. A lemon-sized mass was

palpable in the epigastrium just to the left of the midline. There was no hepatosplenomegaly. Hb. 82 per cent, R. B. C. 3,970,000, W. B. C. 6,760, P. 81, L. 18, M. I. Urine negative. An Ewald test meal showed free HCl 38, total acid 55. Stool had a 4+ guaiac. Wassermann negative.

Roentgenologic examination of the stomach showed 100 per cent six-hour retention, and nothing could be forced through pylorus. The antrum was fixed, tender and inflexible and showed no peristalsis. Impression: An extensive carcinoma of the antrum, invading and involving pylorus (gastric lues was considered a possibility).

Operation.—June 25, 1935: Under spinal anesthesia patient was explored by Dr. J. F. Roberts through a transverse incision. A rounded elastic tumor was found involving the pylorus and extending up on lesser curvature. Posteriorly it was bound down to the pancreas. There appeared to be infiltration by tumor of the gastrohepatic omentum. Several small perigastric nodes were palpable. A resection seemed inadvisable, and a posterior isoperistaltic gastrojejunostomy was performed. He had a smooth postoperative course, except for some evidence of atelectasis on second day. Examination by Dr. V. F. Frantz of the specimen removed from gastrohepatic omentum showed it to be simply a peritoneal band with some fibroblastic proliferation. The question was raised whether the changes might be due to syphilis. Patient was discharged July 14, 1935 on an ulcer diet and was to receive antiluetic treatment.

Subsequent Course.—He was relieved of pain during the following month, but despite antiluetic treatment, the lesion in stomach progressed to involve the duodenal bulb. Roentgen ray diagnosis, August 1, 1935, was carcinoma of antrum, probably not lymphoblastoma. He was readmitted for attempt to resect, in view of the negative biopsy.

Second Operation.—August 8, 1935: Under spinal anesthesia, Dr. J. F. Roberts demonstrated a stony-hard tumor involving the lower half of the stomach and upper portion of duodenum. It was adherent to the adjacent structures and to the old incision. The lesion extended to within 4 cm. of the old posterior gastro-enterostomy. Lymph nodes seemed to be free of disease. The first part of the duodenum and the stomach were resected up to the old posterior gastro-enterostomy. The patient had an unusually smooth postoperative course and was discharged September 4, 1935. Readmitted October 12, 1935, because of evidence of wound infection. This was relieved by instituting adequate drainage. Roentgenotherapy was begun September 3, 1935. G. I. series, February 10, 1936, was negative for recurrence. Readmitted April 30, 1936, complaining of pain in lumbar region and right flank. The abdomen was distended, and a sizable mass was palpable in midabdomen. Some abnormality of the right kidney was shown by retrograde pyelogram but surgery was not advised. Patient continued downhill after discharge April 18, 1936, and died June 1, 1936.

Roentgenotherapy.—September 3, 1935 to December 18, 1935: Received 2,300r. through an anterior portal over the stomach to area 10x10 cm., in divided doses of 100-150r. The factors were 190 K. V., 50 cm. T. S. D., 8 m. a., filter 0.5 Mm. Cu. + 1 Mm. Al. 600r. was given through each of two portals over palpable recurrences, between April 8, 1936 and May 5, 1936. The factors were 190 K. V., 50 cm. T. S. D., 8 m. a., filter 1.86 Mm. Cu + 1 Mm. Al.

Pathologic Examination.—Dr. F. M. Smith. *Gross:* The peritoneal surface is smooth and contains no suggestive tumor nodules. A portion of pancreas is adherent to the posterior wall near pylorus. On opening the stomach, it is seen to be almost entirely filled by a large, smooth spongy tumor completely denuded of mucous membrane (Fig. 4). The line of resection is within 0.5 cm. of the proximal line of resection. The tumor is elevated above the normal mucous membrane and in the antrum completely encircles the lumen. It has grown in such a manner as to form a crater-like depression at one point, where there is ulceration. Subadjacent to this there is a large area of necrosis in the tumor. In some areas the tumor has attained a thickness of 2 cm. and has infiltrated all of the layers except the serosa. *Microscopic* section shows a small round cell tumor which has replaced nearly all elements of stomach wall (Fig. 5). Occasional fragments

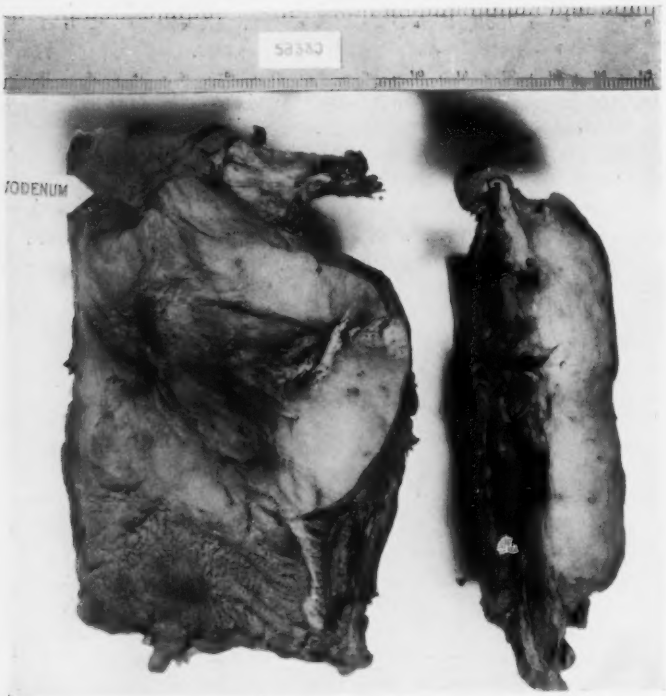

FIG. 4.—Case 2: Stomach specimen. There is marked thickening of the antrum where the tumor completely encircles the stomach. Ulceration and necrosis is clearly seen in the crater-like center of the tumor. Attached duodenum appears uninvolved. The cross-section, on the right, shows the enormous thickening of the wall.

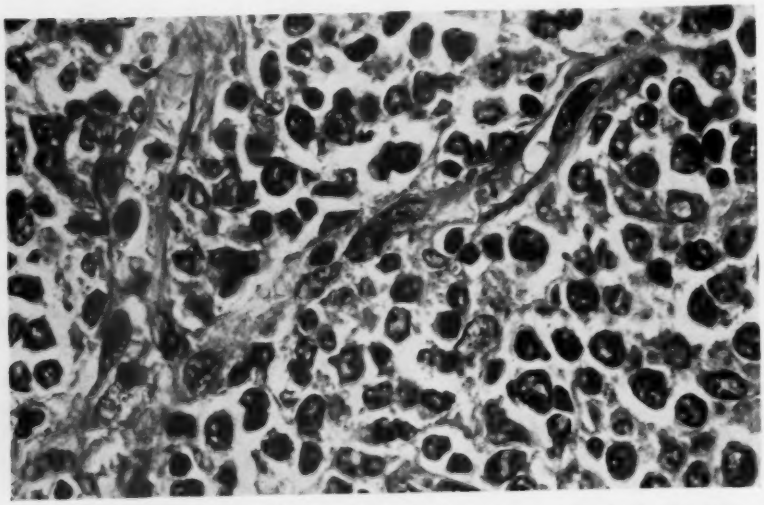

FIG. 5.—Case 2: Photomicrograph of a section of the stomach clearly demonstrates the morphology of the normal tumor cells lying in a scant supporting frame work. (×1100)

of mucous membrane and nests of acid glands are seen, and nearly all of the muscle is replaced. The serosa is involved, but the lymph nodes are not. The tumor invades up to the line of resection. The individual cells are the size of small lymphocytes with a small amount of clear cytoplasm and hyperchromatic nuclei, often eccentrically placed. There is little supporting stroma and practically no fibrosis nor inflammatory reaction. There are some areas of liquefaction necrosis.

This is a lymphocytic cell type of lymphosarcoma of the bulky polypoid variety. The difficulty of making a correct diagnosis of the disease, even upon direct examination, is well brought out. The roentgenologist's note concerning the flexibility of the walls is perhaps the only suggestive finding, even in retrospect. Microscopically this appeared to be a radiosensitive tumor, yet the amount of roentgenotherapy given presumably did little but relieve pain, and death ensued within 10 months after resection.

Case 3.—No. 222561: I. K., female, age 36, married, was admitted to the hospital September 13, 1933, complaining of loss of weight, weakness and vomiting for one year. First admission, September 18, 1929, was for partial thyroidectomy for adenoma of thyroid. March 10, 1932, at second admission, had a full term spontaneous delivery at which time added diagnosis of fibromyoma of uterus was made. First G. I. symptoms were in 1930, with vomiting p. c. without pain. A G. I. series, December 22, 1930, was suggestive of an anomalous first part of duodenum possibly associated with gallbladder disease. January 2, 1931, gallbladder dye series was negative. Patient continued to have distress intermittently despite a dietary regimen but went through a second pregnancy in 1931-2. She developed more distress and anorexia during February, 1933. A second G. I. series was done March 5, 1933. Peristalsis was present only on the greater curvature and was irregular. The prepyloric region appeared narrowed. This was first considered an early sclerotic type of carcinoma, but a review of films did not substantiate this point and the patient was placed on a diet. She continued to have vomiting, anorexia and began to lose weight. A gastric analysis showed free HCl 16, total acid 29. Another G. I. series demonstrated the picture of advanced carcinoma of stomach involving the posterior wall and greater curvature, in the pars media; "a surprising amount of mobility is present in considering the size of the associated mass." Patient was readmitted September 13, 1933. Hb. 62, R. B. C. 3,970,000; W. B. C. 13,300, P. 81, L. 16, M. 3, Stool guaiac 4+. No free HCl found in gastric expression.

Operation.—September 18, 1933, through a left paramedian incision under spinal anesthesia a Pólya type of partial gastrectomy with posterior gastro-enterostomy and entero-enterostomy was performed by Dr. F. Meleney. Her postoperative course was uncomplicated. She was discharged to a convalescent home on the twenty-fourth postoperative day.

Subsequent Course.—Readmitted October 31, 1933, complaining of abdominal cramps for two days and back pain. She appeared quite weak and emaciated. A questionable mass was palpated in the left upper quadrant. A G. I. series showed no definite evidence of recurrence. The severe cramps were relieved by roentgenotherapy and patient discharged November 23, 1933. Presented herself March 7, 1934, two months pregnant. A therapeutic abortion was performed March 17, 1934. She did well until May 2, 1934, when cramps returned and she began to have difficulty in swallowing. A routine G. I. series was equivocal, but a thick meal showed narrowing and distortion of the esophagus at the cardia, which was considered to be a recurrence in the wall of the esophagus. Partial relief followed roentgenotherapy until September 1, 1934, when vomiting and difficulty in swallowing precluded all eating. A definite mass noted in epigastrium, and a G. I. series showed multiple defects in stomach. She could tolerate no further roentgenotherapy and was referred for terminal care. She died October 26, 1934, 13 months after operation.

Roentgenotherapy.—November 15, 1935 to January 19, 1934: Received 1,800r. in divided doses of 100-120r. through anterior portal to area 15x15 cm. over mass. The factors were 180 K. V., 50 cm. T. S. D., 4 m. a., filter 0.53 Mm. Cu. and oil. Subsequently (February 2, 1934 to February 23, 1934) a similar field over suspected mass below

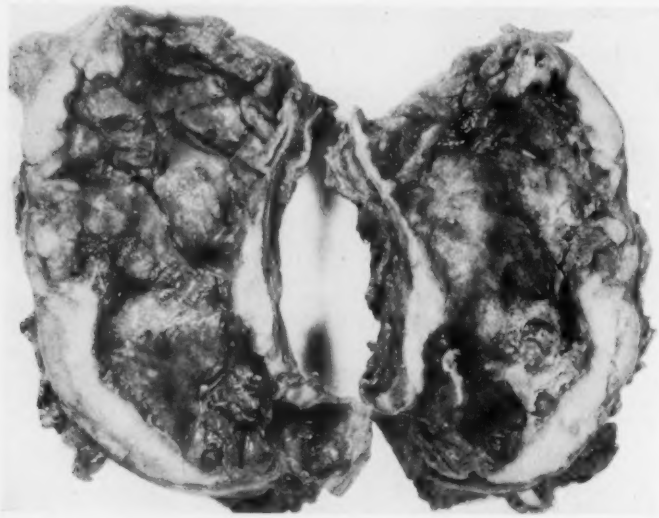

FIG. 6.—Case 3: Operative specimen with stomach bisected and pylorus below, shows involvement of practically the entire greater curvature and a portion of the lesser curvature. The extent of the thickening of the wall is clearly seen.

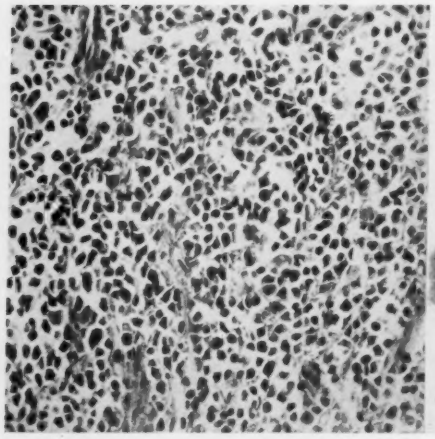

FIG. 7.—Case 3: Photomicrograph showing that the polygonal tumor cells are seen to vary somewhat in size but resemble the reticulum cell of the lymphoid system. No tendency to acini formation is observed. (×500)

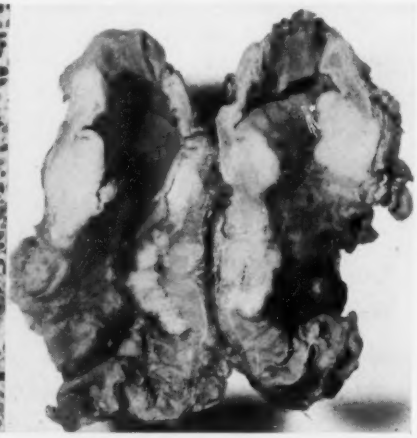

FIG. 8.—Case 4: Gross' specimen of the stomach as removed at operation. Specimen bisected with pylorus at the top. The massive, bulky tumor is seen to be fairly well demarcated from normal mucosa as the cardia is reached.

and to left of original area received 600r. The factors were 190 K. V., 50 cm. T. S. D., 8 m. a., filter 0.55 Cu. + 1 Mm. Al. In May, 1934, 625r. were given anteriorly to area corresponding to esophageal and cardiac involvement. An incomplete series was given just before patient's death in September, 1934. In all, 4,800r. were given in six series over a period of seven months.

Pathologic Examination.—Dr. A. P. Stout. *Gross:* There is a large soft nodular tumor with a superficially ulcerated surface which extends from the pyloric ring for a distance of 10 cm. along the lesser and 17 cm. along the greater curvature, completely encircling the stomach (Fig. 6). The thickness varies from 5 to 20 Mm. and in most areas the muscle coat although invaded has not been completely penetrated. The tumor appears to end abruptly just as the pyloric area is reached, and resection is ample as a part of duodenum is excised distally. *Microscopically,* there is disease one millimeter from proximal line of resection. The tumor cells are polygonal and vary greatly in size and shape (Fig. 7). The nuclei are hyperchromatic and the cytoplasm is well defined and amphophylic. There are many mitoses. The cells are arranged in foliate pattern in a delicate reticulum with no tendency to form acini. The lymph nodes removed contain sinuses dilated with lymphocytes and polygonal cells similar to the tumor cells in stomach.

This is a lymphosarcoma of the reticulum cell type. Unfortunately, there was some question on first examination whether or not it was an anaplastic carcinoma, and for this reason there was a delay in administrating roentgenotherapy.

Case 4.—No. 81486: J. M. K., male, age 64, married, was admitted to the hospital April 17, 1929. Always had general good health in past, except for "hunger pain" for 20 years. In 1925, had pain low in abdomen, not related to eating but relieved by soda and food. In 1927, began to lose weight and vomited occasionally. A diagnosis of ulcer was suggested, without roentgenologic examination. Patient gained 20 lbs. after nine weeks of diet and bed rest. Patient had hematemesis and tarry stools in September, 1927 and he was in bed six weeks. He remained asymptomatic until December, 1928, when the pain recurred. Had a remission again until April, 1929, when the pain recurred. Patient had had a hematemesis the day before admission. On admission he complained only of "gas" and epigastric pain. Physical examination was equivocal except for some pallor and abdominal distention. There were no signs of shock. He was placed on bleeding ulcer regimen with nothing p. o., and given hypodermoclyses and rectal instillations. Hb. 43 per cent, R. B. C. 3,460,000, W. B. C. 13,050, P. 74, L. 24, M. 2. Urine was essentially negative. He showed no evidence of further gross hemorrhage and was placed on a modified Sippy regimen, April 19, 1929. He improved slowly, having pain only at night. Stools on five consecutive days were negative to guaiac. Gastric analysis showed a free HCl 14, total acidity 54. On May 15, 1929, a G. I. series demonstrated a broad incisura on the greater curvature of the stomach with narrowing of lumen to about one centimeter. The lesser curvature in this region was somewhat irregular. Peristalsis was present above and below this region but did not pass through it. Stomach walls were quite flexible. There was a 25 per cent gastric retention at six hours. "Findings are those of gastric ulcer." He received four transfusions 600-800 cc., which brought his Hb. up to 100 per cent. However, he continued to show some gastric retention and, June 4, 1929, a second G. I. series showed the marked constriction persisted and a small projection was noted on the lesser curvature side at this point. There was a six-hour retention of 50 per cent. He was discharged with diagnosis of gastric ulcer.

Subsequent Course.—He was readmitted, November 12, 1929, as he had episodes of severe pain during summer months. Stool examinations were persistently positive for blood. He also had had one small hematemesis. A recent G. I. examination showed a large, greater curvature crater which suggested carcinoma. Hb. 88 per cent, R. B. C. 4,770,000. He had had no weight loss. Because of the persistence of bleeding and the roentgenologic findings, operation was decided upon.

Operation.—November 13, 1929: Under spinal anesthesia and drop ether, the abdomen was explored through a T-shaped incision, by Dr. A. O. Whipple. A large ulceration was found on greater curvature with infiltration on lesser curvature and posterior wall extending well to the cardia. Although it appeared almost impossible to get above

the lesion, which was considered to be a carcinoma, it was decided to resect in view of absence of metastases in liver and adjacent lymph nodes. A Bilroth II with gastro-jejunostomy and entero-enterostomy was performed. A drain was placed down to duodenal stump because of insecure inversion. A 700 cc. transfusion was given post-operatively. Smooth course postoperatively, except for development of gastric fistula on the eighth day. This was exceedingly bothersome often draining 1,500 cc. in 24 hours; it, however, healed slowly and the patient was discharged in generally good condition on the thirty-eighth postoperative day. He subsequently developed a large ventral hernia.

Pathologic Examination.—Dr. A. P. Stout. *Gross:* The stomach is rather bulky and rounded. Peritoneal surface is smooth. On opening the organ just above the pylorus, the wall becomes suddenly thickened to 16 Mm. (Fig. 8). This thickening encompasses the entire circumference and extends along the lesser curvature for 2 cm. and the greater curvature for 5.5 cm.

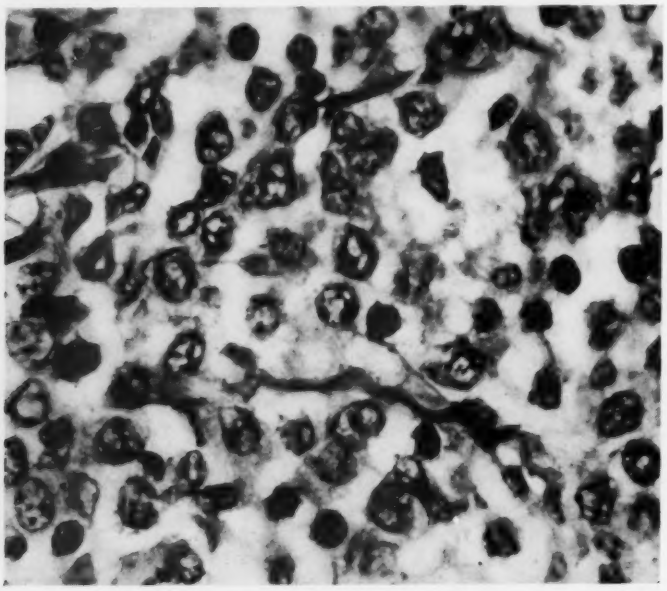

FIG. 9.—Case 4: Photomicrograph of a section through the tumor, showing the tumor cells, cuboidal in shape, and having large hyperchromatic nuclei. There is very little supporting frame work. (×1100)

Microscopic.—A section through tumor mass shows that it is composed of solid masses of small cuboidal cells separated by fibrous tissue strands (Fig. 9). An unusual power of infiltration is noted without corresponding destruction. The individual cells are hyperchromatic with large nuclei and small cell body. Mitoses are frequent. The mucous membrane retains semblance of its architecture but tumor tissue widely separates the glands. There is no attempt at gland formation by the tumor cells. Tumor cells are noted in lymphatic spaces. Proximal line of resection goes through tumor bearing tissue. Only a very fine supporting framework is noted with special stains. *Pathologic Diagnosis:* Anaplastic carcinoma (?) of stomach.

At no time did this patient receive any roentgenotherapy. He had been regularly followed and repeatedly examined by his personal physician, and when last seen, October 26, 1937, at the age of 73, he was in excellent health and showed no evidence of recurrence—eight years after operation.

This lesion exemplifies the massive bulky type of growth fairly well demarcated from the normal stomach. In retrospect nothing in the symptoms or roentgenologic findings particularly suggested the correct diagnosis.

On reviewing this case in 1934, it was felt that the pathology was that of a reticulum cell lymphosarcoma as was originally suggested by the sarcomatous appearance of the gross specimen. As the patient had remained in excellent health for five years, no roentgenotherapy was suggested.

Case 5.—No. 268878: F. M., male, age 19, was first seen, February 4, 1931, following an attack of syncope associated with body tremors but no actual convulsion. A subsequent neurologic examination was negative, except for hypertension (170/90). Patient showed definite antisocial tendencies and "a type of personality that is always on the defensive." He stated that the convulsive-like seizure was always preceded by right lower quadrant pain. He was seen December 28, 1931 in clinic, complaining of epigastric distress p. c. for two months; partially relieved by food. He had lost 10-20 lbs. He had had a previous operation for right undescended testicle, November, 1928, and an appendicectomy, November, 1929.

Physical Examination showed pallor of face and mucous membrane (blood donor). Carious teeth. Blood pressure 120/70. Abdomen was negative. Hb. 63 per cent, R. B. C. 3,900,000, W. B. C. 6,200, P. 57, L. 35, M. 3, E. 5. Chest film negative. Scout film of abdomen was negative. Wassermann negative. January 5, 1932, three hours after a G. I. series, patient showed typical signs of perforation of a hollow viscus. *Preoperative Diagnosis.*—Perforated gastric ulcer.

Operation.—Dr. D. Bull: A perforation was found on the anterior surface of the stomach in the prepyloric area, with induration extending 10 cm. proximally and 4 cm. distally. Ridged, indurated, enlarged rugae were palpated along the posterior wall through the perforation. A number of enlarged nodes suggestive of neoplastic involvement were palpable. A biopsy of the stomach wall and a lymph node were taken and a simple closure of the perforation was performed, with a free omental graft. He had a very smooth postoperative course. A review of the G. I. series showed a constant incisura at the great curvature near the antrum; with mucosal folds so exaggerated as to give an almost polypoid appearance.

Pathologic Examination.—Dr. A. P. Stout. *Microscopic.*—The stomach biopsy shows an extensive inflammatory reaction. There are many tumor cells varying considerably in size and shape. An occasional mitosis is seen. There is no tendency to glandular arrangement. The cells do not form mucin. Many of the cells have the characteristics of lymphoblasts (Fig. 10).

The lymph node shows practically complete replacement with tumor cells similar to those in stomach wall. Mitoses are more frequent than in stomach specimen. The connective tissue stroma is meager, but there is slightly more than usually found in lymphosarcoma (Fig. 11).

It was felt from the stomach specimen that this was a highly malignant tumor—either anaplastic carcinoma or a reticulum cell lymphosarcoma. The lymph node, however, was so characteristic of reticulum cell lymphosarcoma that there was no doubt as to the diagnosis and plans for roentgenotherapy were made. After five treatments the patient decided to go away for a rest. He returned, February 17, 1932, and was given a course of 10 treatments.

April 16, 1932, six hours following one of the patient's unconscious spells, he was seen in the Admitting Clinic with typical signs of perforation. An immediate operation by Dr. Bull demonstrated a perforation similar in location to the first one. Because of the dense adhesions and the patient's poor condition, no biopsy or exploration was done. Closure of perforation was easily accomplished by plication, and the abdomen closed

without drainage. Again, he had an exceptionally smooth postoperative course, and was discharged May 1, 1932.

The patient was very refractory to treatment and refused any further roentgenotherapy.

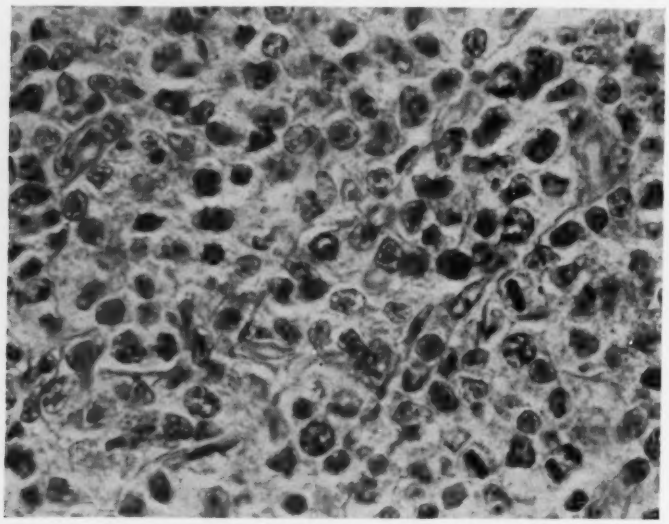

FIG. 10.—Case 5: Photomicrograph of a section of the stomach wall at site of perforation. Note absence of inflammatory reaction. Tumor cells, resembling those of the lymphoblast series, are seen to vary considerably in size and shape. Mitoses are frequent. There is no tendency to glandular arrangement. (×1100)

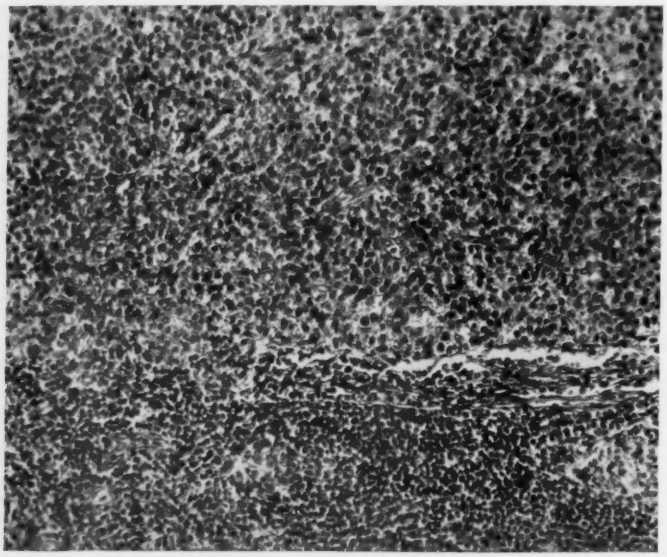

FIG. 11.—Case 5: Photomicrograph of a section of the lymph node, demonstrating the dense infiltration of the tumor cells above, in contrast to the normal lymphoid tissue below. (×250)

A G. I. series was done, March 29, 1933, and showed a constant incisura along greater curvature near the antrum. This was attributed to postoperative scarring. G. I. Series done April 9, 1934, showed no change in the findings. He continued to do fairly well, notwithstanding complete disregard of diet, smoked excessively, and drank freely.

June 12, 1934, he was again admitted for abdominal pain. Abdominal cramps had appeared previously, associated with nausea and vomiting. Bowel movements had been only clear fluid for the previous 48 hours. Three-position roentgenograms of the abdomen confirmed the clinical impression of ileus. He was completely relieved by rectal treatments and parenteral fluids.

The patient continued to do well on a dietary regimen until September 1, 1935, when he again developed abdominal cramps, which were relieved by rectal treatments. A G. I. series, February 20, 1937, gave the impression that there was some thickening of the antral wall, because of decreased activity and some interruption of peristalsis in this region.

He was last seen, September 3, 1937, by a social worker, who found the patient in good health. He had married, in spite of advice to the contrary and has two children. He continues to be refractive to all suggestions as to therapy except when the acute episodes described above occurred.

Roentgenotherapy was completely inadequate, due to patient's lack of cooperation. Through two portals (ant. and post.) over the stomach a total of but 1,380r. was delivered in divided doses, over a period of six months; the patient completing but one full series. The factors were 200 K. V., 50 cm. T. S. D., 8 m. a., filter 1.8 Mm. Cu. + 1.0 Mm. Al. Operatively, nothing was done to alter the course of the disease by way of radical removal. It is perhaps conceivable to believe that this tumor is so radiosensitive that it is kept at least in abeyance by the small amounts of radiation obtained during repeated gastro-intestinal examinations during the years following his first, and only course of planned radiation.

This is a remarkable case of a male, age 25, living and apparently well five years and 10 months after having been shown to have a reticulum cell lymphosarcoma of the stomach of the Type II, described by Pack and McNeer.

In retrospect, this patient shows a number of the findings that have been considered suggestive of lymphosarcoma—his youth; his ulcer-like symptomatology and operative findings; the tendency to perforate; and the original roentgenologic findings of mucous folds exaggerated to an almost polypoidal degree.

Discussion.—Two patients are alive seven, and five years and ten months, respectively; one, with incomplete removal of the lesion and no roentgenotherapy, and the other, with only biopsy and inadequate radiation. This is in distinct contrast to Cases 2 and 3, that had radical excision of the lesion and a greater amount of radiation, only to die from the disease within 10 and 13 months, respectively. A consideration of the other 12 cases of "five-year cure," reveals that a number of these had also received rather unorthodox treatment. Thus, from the analysis of end-results, it is difficult to be dogmatic as to a method of choice in treatment of these lesions as a whole.

It would seem that in the few instances, when the lesion is completely removable, radical surgery offers the best means of cure.

The case for cure by radiation is certainly not as clear-cut from the data assembled. Undoubtedly, remarkable regression of far-advanced lesions often occurs. This is particularly true in more recent years, with improvement in technic. There are at least six cases in the recent literature that have been symptom-free up to two and one-half years, following only roentgenotherapy, and one case (Kaiser, 1934) has gone eight years. However, when apparent cures occur, as in Cases 4 and 5, it becomes difficult to evaluate the absolute

curative results of roentgenotherapy when compared to what might be termed control cases.

It would seem that frequently these lesions have a natural history, individual to the particular case and to a degree independent of the method of treatment. At least, until further knowledge is obtained concerning this neoplasm, not only should every attempt be made to treat these lesions, no matter how far advanced, but also histologically exact diagnosis should be obtained more frequently, before pronouncing a gastric neoplasm beyond therapeutic aid.

SUMMARY.—(1) One hundred forty-seven cases of primary lymphosarcoma of the stomach have been collected from the literature, and five new cases are added.

(2) They have been analyzed as to age, sex, symptomatology, clinical and laboratory data.

(3) Of the 118 patients operated upon, 76 had subtotal gastrectomy, a 50 per cent resectability of the total number of cases (152), with a 15.8 per cent operative mortality.

(4) Thirteen patients are living and well, 5 to 22 years after discovery of the lesion.

CONCLUSIONS

(1) Diagnosis is very difficult; only a single case having been correctly diagnosed preoperatively. There are no pathognomonic clinical findings, and, as yet, no typical roentgenographic appearance. Gastroscopy may, in the future, be a valuable diagnostic aid.

(2) A treatment of choice is difficult to evaluate, due to the number of "cures" that have received what is considered inadequate surgical or roentgenotherapy.

(3) Complete surgical removal is of course ideal, but in only a few cases did this appear possible. Radiation alone, particularly with newer technic, has accomplished clinically complete remission of the disease up to eight years, even in far-advanced cases.

(4) The course of some of the cases, suggests that there may be definite individual variation in their life history that at times is completely unrelated to the type and extent of therapeutic intervention.

(5) Attention is called to the desirability of establishing a histologic diagnosis of a gastric neoplasm before it is regarded as beyond aid.

The author wishes to express his appreciation to Doctors Whipple, Meleney, Bull and Roberts, for the privilege of having access to the cases operated upon; and to Doctor Pappenheimer, of the Department of Medical Pathology, for permission to use the autopsy material presented in Case 1. The author is particularly indebted to Dr. A. P. Stout, for his kind suggestions and criticisms.

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PRIMARY CLOSURE OF PERITONEUM IN ACUTE APPENDICITIS WITH PERFORATION

REPORT OF TWENTY CASES

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DRAINAGE of the peritoneal cavity following appendicectomy for acute appendicitis with perforation is still a problem of universal interest. Statistical analyses are inconclusive, because the absence of a strict classification of cases according to definite criteria establishing the presence of perforation prohibits comparable study in separate reports. Thus Herrick,[17] on the one hand, reports 217 cases with "gangrene or peritonitis" with a mortality of 1.84 per cent, and Totten,[37] on the other, reports 1,044 cases of "perforation" with a mortality of 26 per cent. Other writers use such terms as "localized peritonitis," "cloudy fluid," and "early diffuse peritonitis." Few state specifically whether there is definite evidence of escape of infectious material into the peritoneal cavity. The following study is an attempt to clarify this problem.

Clinical Evidence.—Mikulicz[25] was one of the earliest to discuss the problem of peritoneal drainage thoughtfully. Although he had been, for a time, the proponent of "capillary drainage" by large loose gauze packs, in 1881[24] he stressed the folly of draining noninfectious conditions. During the same period, many surgeons were following the school of Rehn in practicing evisceration, saline irrigation of the peritoneal cavity, and drainage with soft rubber tubes.

Hotchkiss[19] in this country, in 1906, was one of the first to publish a group of cases in which primary closure was practiced. In the interval 1895 to 1899, he treated 12 cases of peritonitis by gauze packing, with 11 deaths. From 1899 to 1903, he treated 15 similar cases; utilizing small incisions, saline irrigations, and a small cigarette drain, with no deaths. In a third series of 28 cases, 16 were not drained, and only one of the five fatalities occurred in this undrained group.

Bauer,[2] in 1911, reported a series of 88 cases, with 10 deaths, the peritoneum being closed tightly in all. Wildegans,[38] in 1923, speaks of markedly lowering his mortality to 25.5 per cent by nondrainage. This is a high mortality, and evidence again of the incomparability of the groups due to individual variation in selecting cases.

Clairmont and Meyer[8] report a 4.07 per cent mortality in 172 cases of early perforated appendicitis, which were treated by appendicectomy. Of these, only 24 were drained. They state that their results show more secondary abscesses than in drained cases, but that "by careful observation and opening

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of these abscesses at the proper time a larger number of patients will get well by a smoother course, and a larger number of patients will remain permanently in good health than will be the case with other procedures, above all with drainage."

Hall[16] reported 12 cases of perforated appendicitis with "thick pus in the peritoneal cavity," in which the peritoneum was not drained, with no deaths and no pelvic abscesses. Shipley and Bailey,[32] and Shipley[33] practiced nondrainage in many cases of "early diffuse peritonitis." They had no deaths and one secondary abscess. Their criterion of early peritonitis was optical evidence of purulent peritonitis "with the intestines still smooth and glistening."

Marchini[23] found that in cases with local peritonitis, nondrainage resulted in a 1.7 per cent mortality as compared with 5 per cent in the drained cases. In cases with diffuse peritonitis, those without drainage showed 20.6 per cent deaths as against 30.6 per cent in the drained. Cafritz,[7] Kulenkampff,[22] and Muelleder[27] also report a lower mortality.

Colt and Morrison[10] present 105 drained cases of perforated gangrenous appendicitis with six deaths as compared with 28 undrained cases with no deaths. These observers, however, do not accept this as final evidence that nondrainage is better, because in their opinion the sickest cases were drained. Finally, Giertz's[13] experience over 25 years with peritonitis, in which he reports a gross mortality of 8.35 per cent in 1,728 cases with nondrainage, with 172 secondary abscesses, is important. It was his influence that inspired the initiation of the Peter Bent Brigham Hospital Series in 1936.

The arguments in favor of drainage have been several. In the period before asepsis, it was used as a prophylactic measure in the great majority of all celiotomies principally by the early gynecologists, such as Sims, Oldshausen, and Tait. To Tait, is ascribed the authorship of the saying "when in doubt drain." Some authors say, that although the drain becomes sealed off from the peritoneal cavity, it acts as an irritating foreign body and reverses the lymph flow away from the diaphragm toward the drainage sinus (Herrick,[17] Totten[37]). Others feel that the liberation of exudate is important from the point of view of the patient's toxic reaction. The chief argument for draining, however, is that the surgeon believes that he has thereby exteriorized the infection. He is mentally more at ease, if the thickness of the abdominal wall is not between him and the suppurative focus. Bunch and Doughty[6] report a series of 139 cases of deferred operation in generalized appendiceal peritonitis, with a mortality of 1.93 per cent. As a practice, they are in favor of drainage in the cases operated upon. Deaver and Pfeiffer[12] and Sworn and Fitzgibbon[36] also advocate drainage.

Experimental Evidence.—There has been considerable experimental work to show that intraperitoneal drains are ineffectual and even harmful. Yates'[40] work, in 1904, which showed that in dogs a drain introduced through an incision in the abdominal wall fails to communicate with the general peritoneal cavity after six hours, is well known. Carmine injected into the cavity elsewhere could not be made to pass out through the drain tract, even under

pressure. He found that this six-hour period was shortened in the presence of infection, and that the adhesions formed in infectious cases that were drained were more dense and harbored organisms longer than those in nondrained cases. Rost[29] showed that after 12 hours, fluid injected into a drainage tube could no longer be made to pass into the peritoneal cavity but regurgitated around the tube. Buchbinder, Droegemueller, and Heilman[5] produced peritonitis experimentally in dogs by creating an isolated open loop of intestine and then attempted to treat the peritonitis surgically. In a series of 33 dogs, they found that if the perforated focus w. s excised and the peritoneum tightly closed, the mortality was 58 per cent. If the same was done with establishment of drainage, the mortality in 20 dogs was 100 per cent. If no surgical procedure for treatment was performed, the mortality in 31 animals was 90 per cent. The cause of death in the dogs was toxemia from peritonitis. In every case the drains were encapsulated with dense adhesions. Shambaugh and Boggs[30] created intraperitoneal drainage tracts in guinea-pigs and dogs in order to test their resistance to infection. They found that the peritoneum and surrounding tissues could not be infected with virulent organisms poured into these tracts after the fourth day. This seemed to indicate that after that time a tract does not communicate with the peritoneal cavity and, therefore, cannot drain it.

MATERIAL CONSIDERED.—The present study consists of a comparison of drained and nondrained perforated cases in the five-year period 1933 to 1937, inclusive. To be considered in this series, a case must have satisfied *one* of three criteria: There must have been free organisms in the peritoneal cavity at the time of operation, proven by culture; there must have been an open perforation, described by the operator in his operative notes; or there must have been an open perforation, described by the Pathologic Department in its report. According to these standards, 111 cases were found, 91 drained and 20 not drained. Table I shows the evidence for perforation in each group.

TABLE I

EVIDENCE OF PERFORATION IN 111 CASES OF PERFORATED APPENDICITIS

	Localized Abscess 34 Cases		*Diffuse* 77 Cases	
Nature of Evidence	With Drain 31 Cases	Primary Closure 3 Cases	With Drain 60 Cases	Primary Closure 17 Cases
B. coli culture	21	2	34	17
Hemolytic Strep. culture	1			
B. proteus culture	1		1	
Nonhemolytic Strep. culture	1	1	1	
B. fecalis alkaligenes culture			1	
Staphylococcus aureus culture			1	
Obvious perforation at operation or in pathology	7		22	2
Ruptured on removal				1

The comparison of the two groups has been pursued with regard to the various complications unfortunately so familiar in cases of appendicitis. The questions of fecal fistula, wound infection, secondary abscess, postoperative reaction, and death have been dealt with separately. Table II shows the results of this investigation.

ANALYSIS OF CASES.—(1) *Fecal Fistula:* That nondrainage is not a guarantee against fecal fistula, is shown by a recent study by Strauss and Tomarkin[35] at Mt. Sinai Hospital in New York. They found 0.5 per cent of fistulae in those cases closed without intraperitoneal drainage. In our 20 cases, however, we have had no fistulae. In 83 cases of our series that were drained, four, or 4.8 per cent, developed fistulae. Our impression is that the drain is the single most important factor in the causation of fistulae.

(2) *Wound Infection.*—In spite of every attempt to protect the wound with towels, gauze, or other means, at the time of opening the peritoneum, nearly 100 per cent of infections are to be expected. If the case is drained, very often the intraperitoneal wick will also serve to drain the wound if it is small. In wounds through which an intraperitoneal drain does not pass because nondrainage is being practiced or because a stab wound drain is inserted at a more convenient site, either the wound must be left open down to the fascia or adequate superficial drainage with rubber tissue should be established. In the whole series there is not a case, drained or undrained, whose wound did not show some evidence of infection important enough to be mentioned in the postoperative notes. One case, in which the wound was closed tightly because of lack of clinical evidence of peritonitis, later had a colon bacillus grow on the culture medium and four days postoperatively showed evidence of wound infection.*

(3) *Secondary Abscess.*—The incidence of secondary abscesses has been rather carefully gone into. Clairmont and Meyer,[8] as has been mentioned, found 28 per cent of secondary abscesses. Two-fifths of these required drainage and three-fifths absorbed spontaneously, Giertz[13] found 172 abscesses in 1,728 cases, or only 10 per cent. In the present series, 17.5 per cent of the drained group and 60 per cent of the undrained group showed some evidence of secondary abscess formation. By abscess is meant any tender mass palpable abdominally or by rectum, not necessarily all requiring drainage. The incidence of abscesses requiring some form of drainage was 8.7 per cent and 20 per cent, respectively. The great majority of these were abscesses in the pouch of Douglas, requiring colpotomy or rectal drainage.

(4) *Postoperative Obstruction.*—The problem of postoperative adhesions causing obstruction to the intestines is particularly elusive of satisfactory analysis. Totten has minimized the responsibility of the drain as the cause

* One very early perforated case, with a positive *B. coli* peritoneal culture, which did not develop wound suppuration, has been seen since this series was recorded. This case, however, had unexplained fever and leukocytosis for three days, during the middle of his convalescence. After repeated hot applications, the reaction disappeared, leaving no evidence of inflammation in the wound.

of immediate postoperative obstructive symptoms. Inquiry into the incidence of late obstruction reveals so few individuals in the community at large who fall in the undrained group, that a just comparison cannot be made. None of the 111 cases tabulated could be analyzed from this viewpoint. Accordingly, 25 consecutive cases entering the Peter Bent Brigham Hospital with intestinal obstruction due to postoperative adhesions were studied. Only cases in which it could be definitely ascertained whether the previous operation had been drained or not, were considered. The exact nature of the previous operation and, indeed, often the condition for which it had been performed, could not be determined in many of the cases. It was found that of the 25, 15 had been drained and 10 had not. Our clinical impression is, and the above small series would seem to indicate, that the drain, in clean cases, contributes to a higher incidence of postoperative obstruction. The same cannot definitely be said in the cases of peritonitis with which we are dealing.

TABLE II

COMPARATIVE STATISTICAL STUDY OF 111 CASES OF PERFORATED APPENDICITIS, WITH AND WITHOUT DRAINAGE

		Mortality		Incidence of Secondary Abscess		Fecal Fistula	Wound Infection	Postoperative Reaction		
		Due to All Causes	Due to Peritonitis	Totals	Requiring Drainage	Total Incidence	Total Incidence	Average Maximum Temperature	Average Days Before Temperature Normal	Average Days Before First Bowel Movement
Undrained	Localized abscess, 3 cases	0	0	0	0	0	100%	In 3 cases, 101.6° F.	In 3 cases, 14.2 days	In 3 cases, 5.0 days
	Diffuse, 17 cases	3, or 17.6%	1, or 5.8%	In 15 cases * 9, or 60.0%	3, or 20.0%	0	100%	In 17 cases, 103.0° F.	In 17 cases, 15.2 days	In 17 cases, 4.7 days
Drained	Localized abscess, 31 cases	2, or 6.4%	2, or 6.4%	0	0	—	100%	In 30 cases, 102.1° F.	In 24 cases, 11.7 days	In 30 cases, 5.2 days
	Diffuse, 60 cases	11, or 18.3%	9, or 15.0%	In 57 cases 10, or 17.5%	5, or 8.7%	In 83 cases 4, or 4.8%	100%	In 50 cases, 102.8° F.	In 48 cases, 11.8 days	In 50 cases, 4.4 days

* Hereafter, the number of cases analyzable is somewhat diminished through deleting those which died too early for consideration.

(5) *Postoperative Reaction.*—The best evidence that can be procured from the hospital records as to the extent of the postoperative reaction, we have considered to be the maximum postoperative temperature; the number of days before the temperature returns to a normal level, to stay; and the number of days, postoperatively, before the patient has the first spontaneous bowel movement. It can be seen from Table II that the undrained group shows a slightly greater postoperative reaction according to these standards. The fact that the temperature in the undrained group remains elevated longer, is probably explained by the fact that secondary abscesses were more common.

This period, conceivably, might have been shortened by earlier drainage of the abscesses in some of the cases.

(6) *Mortality.*—The total mortality is 14.4 per cent. The mortality in the abscess cases is low, 6.4 per cent, while that in the cases without abscess is high, 18.1 per cent. This latter figure is divided about equally between the drained and undrained groups, being 18.3 per cent to 17.6 per cent, respectively. It can be seen, however, that if the cases are considered from the point of view of the cause of death, one, or 5.8 per cent, of the cases without abscess that were undrained died of toxemia or peritonitis. Of the other two, one died of a pulmonary embolus on the fourth day and the other, a case with advanced peritonitis, died on the operating table, probably an "anesthetic death." Of the similar drained group, the same correction brings the mortality down to 15 per cent.

Operative Indications and Technic.—At the Peter Bent Brigham Hospital, operation is performed immediately upon all cases of appendicitis seen within the first two days after the onset of symptoms, who are not too sick to stand the procedure. More advanced and longer standing cases, we tend to treat along the lines proposed by Ochsner.[28] Each case is considered an individual problem, however, without establishing any arbitrary limit of time, such as 48 hours. In cases of abscess, in which the diagnosis is clear, we attempt to perform operation as an elective procedure, preferably after the first week. The patients with abscesses require the closest observation because, although intra-abdominal rupture of the abscess is rare, it has been reported (Bunch and Doughty[6]). The McBurney incision is employed when the diagnosis is clear preoperatively, adding a Rockey extension into the right rectus sheath when necessary. Peritoneal cultures are taken routinely. Silk technic is used throughout, although the peritoneal suture is often changed to catgut. The peritoneum and fascia are closed and the skin and fat left open in all undrained cases in our perforated group. Occasionally, the deeper layers of the fat are approximated with interrupted silk. It may be added that the use of fine silk does not in any way hinder the healing of the wounds in the presence of infection. If any of the ligatures work loose they are carried to the surface by the granulation tissue. The granulation tissue grows rapidly around those that remain fixed (Shambaugh and Dunphy[31]), and small sinuses have not developed, as occasionally happens in wounds where heavy silk is used. Due to the fact that the incision is made in the line of skin elasticity, there is no tendency for the wound edges to separate, and in all cases, except those in which there is a tendency toward keloid formation, an almost hairline scar is left. The immediate cosmetic result is, indeed, remarkably good because of the lack of stitch scars. Postoperatively, the peritonitis cases are put on an Ochsner type of regimen, with a Wangensteen suction attached to a Levin tube in the stomach, until audible peristalsis occurs.

Comment.—The methods of procedure outlined have impressed us favorably. The patients, on the whole, do not seem as sick in comparison

with the drained cases as the figures might seem to indicate. We believe that an abdominal wound which does not have a drain through its complete thickness is more comfortable than one which has. Certainly the lack of a profuse, continual discharge of pus, with a fecal odor, is a help to the morale of the patient and makes the dressings more comfortable.

We do not know what would happen if any of our cases of large collections of pus in abscess cavities were closed primarily. Our opinion is that the abscess wall contains so much necrotic material that external drainage is necessary for eventual discharge of the slough. Of our three "abscess" cases, that were not drained, there were none which showed large pus collections. They were all small, localized collections without thick walls.

It is obvious that the criteria we have used to include cases in this series have their limitations. They indicate nothing as to the amount of peritoneal infection the patient may have at the time operated upon or the extent of his immunity response to it, factors which must always be considered in estimating the prognosis in these cases. We do feel, however, that they are considerably more concrete than other classifications heretofore used, and that the question can only be settled by working along such lines.

Because of the small series of cases, it may be justly argued that the mortality percentage figures are not final. Notwithstanding this, the fact that only one of our 20 patients died of peritonitis is good evidence that nondrainage is not a harmful procedure. Added to this is the fact that the above mentioned patient was one who had had symptoms for three days and had taken cathartics, one whom under ordinary circumstances we should treat without immediate operation.

SUMMARY.—(1) Strict criteria for establishing the presence of perforation in cases of appendicitis have been formulated.

(2) Of 111 cases satisfying these criteria over a five-year period, 91 had intraperitoneal drainage and 20 primary peritoneal closure.

(3) A comparison of these two series shows in the undrained group, a lower mortality rate and lessened incidence of fecal fistula, but a higher postoperative reaction and increased incidence of secondary abscess.

CONCLUSION

Primary closure of the peritoneum in perforated appendicitis without abscess is a safe procedure, and warrants further trial in an effort to lower the high mortality rate.

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CONGENITAL CYSTIC KIDNEY TREATED BY URETERAL DRAINAGE*

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THERE is a fairly wide consensus of opinion among surgeons that in most cases of congenital cystic kidney surgical intervention is without value.

Medical treatment for this condition follows the indications for combating the various forms of renal failure coming under the generic term Bright's disease; and consists of medication, dietetics, hydrotherapy, mental and physical rest, and, when possible, having the patient live in an equable climate.

Observations on the treatment of a limited number of these patients during the past 20 years have led to the belief that many of them have bilateral ureteral stricture, which condition augments the renal stasis caused both by the multiple cysts and, in some cases, by lateral pressure of the mass against the upper ureter.

If these observations are supported by other investigators, we will have a comparatively simple method, embracing both medicine and surgery, for relieving symptoms, improving the general well-being and prolonging life in these cases where, too often, the outlook has seemed rather hopeless.

The discovery that ureteral stricture occurs in many of these cases emphasizes the great importance of an early diagnosis. Too often, clinical symptoms of sufficient urgency to drive the patient to a physician do not develop until there has been such complete destruction of the renal tissue that the victim is already in a fatal uremia; or the accompanying vascular changes have led to an intracranial accident. Formerly, in the face of such tragedies the physician could assuage the grief of relatives by the observation that, even had an earlier diagnosis of the true condition been made, science held no remedy for a long postponement of the event.

What are some of the difficulties preventing an early diagnosis? Because of its rarity, the average practitioner and even the experienced urologist, too often, overlook the significance of signs and symptoms which fairly clamor for a correct diagnosis.

The disease is generally conceded to be of congenital origin; it may be transmitted through the male or female, and at times, as Crawford[1] and others have shown, it occurs in many members of the same family. Apparently it occurs with equal frequency in the two sexes. Braasch,[2] in reporting on the vast material of the Mayo Clinic, found that in 193 patients with this disease, 98 were females and 95 males. These facts should lead us to earlier diagnoses, particularly if there is a suggestive family history of renal disease. An unexplained history of recent loss of weight, general malaise, anemia, headache, or gastro-intestinal disturbances should make us suspect a possible

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origin for these symptoms in the urinary tract; and if, in addition to such symptoms, there is a history of backache, pain in the flanks, or bladder disturbances, we are placed on guard to examine most carefully for enlargement or tenderness of the kidneys, and tenderness on palpation over the ureters. These patients sometimes consult the physician with the sole complaint that they have discovered "a lump in the side," but even in such cases, careful questioning elicits the fact that the patient is below par in initiative and endurance, is subject to headache, or has dull discomfort in the lumbar region, various gastro-intestinal symptoms, or disturbances of the bladder function. Any one or more of these symptoms may have been present for so many years, and have so successfully thwarted sporadic efforts at medical relief that the patient finally has taken the fatalistic attitude that he is destined to put up with them, and is jolted into the advisability of another medical consultation only by the discovery of a mass in the side.

With the above history, and an enlargement or abnormal position of one or both kidneys, and the demonstration of tenderness along the urinary tract, omission of a thorough examination of the upper tract is inexcusable. Should the urine show albumin, casts, or other signs of pathology, and should the functional test show a deficiency, or should there be hypertension, or ocular, or other signs of a cardiovascular disturbance, the thorough examination of the upper urinary tract is even more imperative. With the total picture as above presented, one which is so suggestive of chronic Bright's disease, it is fortunate for the patient that, with the most systematic examination of the upper urinary tract, only in rare instances will we be able to demonstrate the condition of bilateral polycystic kidney.

The presence of large bilateral masses in the flanks is the most suggestive physical sign of this disease, but even with the discovery of such masses, the diagnosis is not completed. We need careful roentgenologic studies to differentiate between polycystic disease and bilateral tumor, bilateral hydro- or pyonephrosis, bilateral calculus disease, bilateral renal tuberculosis, and bilateral perinephritis. Since most of these surgical diseases are accompanied by bilateral ureteral stricture, we find in some instances that the bilateral enlargement in the flanks is due to one of these secondary conditions on one side and to another of these conditions on the opposite side.

Usually we gain considerable light on the diagnosis by a plain roentgenogram followed by a series of exposures taken at intervals after the intravenous injection of one of the radiopaque media. However, the intravenous roentgenograms may prove most misleading, and we generally fall back on the retrograde urograms for more accurate data. Since learning of the frequent association of ureteral stricture with most renal diseases needing roentgenologic studies, I have always opposed the retrograde injection of both kidneys at one treatment. Probably in no disease is this more dangerous than in polycystic kidney, and if this condition is suspected, the plain film should be followed by a urogram of one side only, with the catheter in its high position. The catheter should be left in the high position long enough to drain off the injected material, and a salt solution irrigation of the pelvis should follow

before removal of the catheter. If ureteral stricture is present with polycystic disease, ureterograms may be taken with less danger at later sittings, after the narrowed areas have been dilated. Needless to say that the easy and palpably unobstructed introduction of a plain catheter, without a bulb, is not a diagnostic sign of the absence of stricture.

If on palpation of the abdomen, a large mass is discovered in one flank only, this does not exclude the presence of bilateral polycystic kidney. Usually the smaller kidney is palpable and shows signs of some enlargement, and roentgenograms show suggestive enlargement and deformity of the calices.

As noted above, many of these patients give a history more or less characteristic of Bright's disease and the urinalyses and other clinical findings usually duplicate those of Bright's disease. Moreover, as in Bright's disease, early death by uremia, or vascular accident, or by intercurrent disease favored by the patient's condition of lowered vitality, is too frequently the experience of victims of bilateral polycystic kidney.

Histologic studies reveal the amazing destruction of the renal tissues induced by the pressure of the myriads of cysts. Just what influence these pressure effects have on the thickening of the walls of the arteries and arterioles within the kidney, and on the narrowing of the lumen of these vessels, and what relationship these phenomena have to the cardiac hypertrophy and hypertension found in such a high percentage of patients with bilateral polycystic disease of the kidney, are questions still under debate and intensive study (Schacht).[3]

Frederick C. Herrick[4] demonstrated graphically, on two freshly removed autopsy specimens of polycystic kidney, the great influence exerted on the renal circulation by the pressure of the distended cysts. "Normal saline was perfused through them at an arterial pressure of 130 Mm. of Hg. The average of several observations was 315 cc. returning through the vein in five minutes. Without changing the pressure or flow but allowing it to go on continuously, many of the cysts were aspirated with a Record syringe and fine needle; 365 cc. of fluid were thus aspirated from the cysts of one kidney. While so doing the manometric pressure fell from 130 to 10 Mm., although the flow was continuous. The pressure was readjusted at the normal. Now, during the same period of five minutes, the volume flow through the kidney was 1965 cc., over five times the volume flowed before aspiration."

In work with ureteral stricture, we not infrequently have patients present histories and clinical findings that place them with a diagnosis of what is commonly termed Bright's disease. The urologist usually sees only those patients in whom such signs and symptoms are accompanied by some so-called surgical complication, such as hydronephrosis, chronic renal infection, calculus disease of the kidney or ureter, the so-called essential hematurias, and various congenital anomalies of the upper urinary tract. Occasionally the patient with a supposedly purely medical nephritis comes under his care. To see the Bright's disease features of these cases, such as repeated uremic convulsions, persistent hypertension, persistent hematuria, and many of the

lesser evils, such as anemia, fever, headache, dizziness, backache, gastro-intestinal disturbances, and bladder symptoms, greatly ameliorated or entirely cleared up by the simple expedient of restoring good ureteral drainage, is one of the most striking and satisfactory experiences in medicine.

Such experiences, repeated many times, make one question what rôle the stasis caused by ureteral stricture may have in hastening the destruction of the renal tissue in the kidney already damaged by the pressures incident to polycystic disease. In the past, when polycystic disease has been complicated by infection, calculus, hematuria, *etc.*, we have ascribed these secondary complications to the poor circulation in the renal vessels, and to the stasis of urine due to the deformities of the pelvis and calices. No doubt, the lateral pressure of the large renal mass compressing the upper ureter against the spine also plays an important rôle in causing renal stasis in the occasional case. If, however, we can demonstrate that many of these patients with polycystic disease also have bilateral ureteral stricture, we have at hand a comparatively simple method for the amelioration of many of these secondary complications.

Of far more importance will be the ability to improve the health and prolong the life of many of these victims, particularly when we make early diagnoses, and institute ureteral drainage in time to obviate that portion of the renal destruction that is due to the ureteral stasis. This early institution of good ureteral drainage will serve as a prophylactic against many of the secondary complications; but some of them will occur because of the distortion of the calices by the cysts and the consequent interference with good drainage, and, in the occasional case, because of the ureteral stasis caused by lateral pressure of the renal mass. Of course, in seeking to determine why these complications occur in any kidney, we must keep in mind various contributory factors other than inadequate drainage.

In presenting a series of patients having both polycystic disease and ureteral stricture, it may be well to warn the reader that in many of these cases he need not expect to find striking roentgenologic verification of ureteral stricture. Some urologists still depend on the use of the plain catheter, without bulb, together with the roentgenologic evidence, for a diagnosis of ureteral stricture. I[5] have shown that with the Kelly method of air cystoscopy one can use a No. 7, 8, or 9 plain catheter, without bulb, and introduce the catheter to the kidney in two-thirds of the cases suffering from the effects of stricture without detecting evidence of narrowing. The smaller catheters, generally used with the Nitze or water-method of cystoscopy, will certainly miss a larger proportion of stricture cases.

For a number of years, it has been my observation that in the patients who come to the urologist because of renal symptoms, and in whom one of the more common congenital defects of the upper tract is found, the patients' symptoms are not due to the particular anomaly *per se*, but to the presence of some form of ureteral obstruction. In, by far, the greater percentage of these patients the obstruction is caused by ureteral stricture; and in a satis-

factory proportion of them the symptoms are improved or entirely cured by the use of the single method of ureteral dilatation.

Whether the failure of the ureters associated with congenital defects of the kidney, including polycystic kidney, to show roentgenologic evidence of gross dilatation, in answer to the stasis of stricture, is due to an unusual congenital structure of the entire ureteral wall, is a question for future investigation.

For practical, clinical purposes, however, one does find roentgenologic evidence of stricture in most of these cases. In the past many urologists have been missing the finer points of interpretation, and those ureters showing only slight or moderate dilatation, with roentgenologic evidence of one or more areas of filling defect, have been called normal. Unfortunately, they have led many roentgenologists into the same method of interpretation. On withdrawal of the bulbed catheter, the bulb "hangs" in a certain area, or in multiple areas at certain distances above the external urethral orifice. By referring to the ureterogram, usually one can read the filling defects in the otherwise normal-appearing, or only slightly dilated, ureteral lumen, at the areas of narrowing indicated by the bulb test.

CASE REPORTS

Case 1.—Mrs. L. B., age 37, first entered the Medical Dispensary, May 18, 1917, complaining of backache, occasional colicky pains in the right back, and a swelling in the right abdomen, which she had noticed for two years. She had been habitually constipated. The family history did not suggest cardiorenal disease. Large bilateral abdominal masses were discovered and the patient was referred to the cystoscopic department.

Urologic Examination.—Investigation revealed a large mass in either flank, interpreted as being large prolapsed, movable kidneys. The urine was normal. The urethra was densely infiltrated and at the first examination a 5.5 Kelly cystoscope was used. The bladder was normal. A plain catheter without bulb was passed apparently to the right kidney and 40 cc. of clear, normal urine were collected in a rapid flow. Four days later, a catheter with a No. 12 Fr. bulb was used, and on withdrawal, the bulb had a firm "hang" in an area about 4 cm. above the bladder. One month later, the patient returned, reporting great relief from the discomfort in the right side. There had been no return of the severe colicky pains. The last menstrual period had been almost free from the severe pains in the right lower pelvis from which she had suffered all during her menstrual life. A No. 12 Fr. bulb was again used for dilatation. The patient returned six months after the first treatment. She reported great improvement in health. There had been occasional slight pain in the right lower quadrant. The right ureter was dilated with a No. 15 Fr. bulb, which "hung" at 9 cm. from the outside. The kidney took 30 cc. to the point of discomfort. Two days later, the left side was investigated, although none of the patient's symptoms had been referred to this side. The catheter was prepared with a No. 12 Fr. wax bulb, and this obstructed completely when the bulb reached the region of the broad ligament. The patient was treated on both sides a few times during the early months of 1918. She constantly reported good health during this time except for occasional slight pain in the region of the right kidney, and this prompted her to return for further treatment.

The patient was not seen again until April, 1928, when she reported very little discomfort during the previous ten years, and she came in this time because of a new complaint, *viz.*, a dragging sense of pain and discomfort low down in the abdomen and low in her back. Four months previously, she had first noticed what she considered

a proplapse of the womb and this was synchronous with the onset of her pain. The symptoms of prolapse and pain were exaggerated when she was on her feet and working, but completely relieved by rest in bed. The patient had changed from a condition of emaciation to one of obesity during the previous ten years. Her color was good and she did not appear ill in any way. B.P. 150/90, Hb. 98 per cent, W.B.C. 9,500. Right kidney seemed about 2.5 times its normal size and the left about twice its normal size. During the intervening ten years, we had treated several patients with congenital cystic kidney; and now, for the first time, this diagnosis, which should have been perfectly obvious during her first investigation, was made in this case. The cervix protruded through the vaginal orifice, it was deeply lacerated and there was a polypoid growth, about 6 cm. long and quite irregular in outline, protruding from the anterior lip.

A two-hour P.S.P. showed: First hour, 275 cc.—30 per cent; second hour, 525 cc.—10 per cent.

Right urograms, April 10, 1928, with 24 cc. NaI solution. Left urograms, April 12, 1928, with 40 cc. NaI solution. After the Cleveland Clinic fire, all early roentgenograms were destroyed, including those on this patient.

We discussed the advisability of performing an abdominal hysterectomy, which would enable an examination of the kidneys, but vaginal hysterectomy offered a much safer and less depleting operation for the patient. This was undertaken, April 24, 1928. The adnexa were normal and were left *in situ*, and the vaginal vault was carefully suspended by the various ligaments.

The patient was followed for a year after the hysterectomy, having occasional dilatation of each ureter. The right ureter with one stricture area, 9 cm. from the external urethral orifice, was dilated to a No. 16 Fr. The left ureter, with a long, diffuse stricture in the upper ureter and an annular stricture at 6.5 cm. from the outside, was dilated to a No. 17 Fr. Final admission: Five years later, August 3, 1934, which was 17 years after her first visit, the patient was brought to the accident room in convulsions. She was admitted to the medical ward. B.P. 200/90, T. 99.8° F., P. 116, R. 28, Hb. 80 per cent, R.B.C. 4,230,000; W.B.C. 20,000, N.P.N. 210 mg. per cent. Urine: 1,008, large amount of albumin, finely granular casts, a few W.B.C. and R.B.C. Death, at age 54, occurred on the second day after admission. From the family it was learned that the patient had been failing for about eight months. She complained of being worn out, of gradual loss of vision, of aching and cramps all over the body, and of lumbar pain on both sides. For two months, she had eaten very little. For one month she had been extremely nervous and irritable.

Autopsy.—No. 13,787: Congenital polycystic kidneys and liver; mucopurulent bronchitis; emphysema; slight arteriosclerosis.

Gross note on the ureters: "The ureters and pelves are smooth and practically normal in appearance. The pelves are not dilated, perhaps they are a little stretched and elongated. It is difficult to recognize any proper calices. The ureters show no constriction. The bladder seems practically normal." Blocks were not taken from the ureters, and these organs were not saved.

Case 2.—Mrs. A. R., age 43, referred January 7, 1928, by Dr. A. A. Pearre, who had studied the patient's condition at the Frederick City Hospital, and concluded that she needed treatment for a pyonephrosis or a possible renal tumor. The patient was a large-framed woman, weighing normally 182 pounds. She had always enjoyed good health and had been a hard-working woman up to three months previously. The family history was negative except that her father died of Bright's disease. Two children living and well. Menopause, normal, one year ago. Three months ago, complained of a sore, dry mouth and since then has complained chiefly of gastro-intestinal symptoms, aversion to food and water, nausea and vomiting, a sense of fulness and pressure across the upper abdomen. About one month ago, had severe pains in both flanks lasting only one day. No frequency of urination. Thinks the volume of urine has been less than normal as

she has been drinking but little water. Some chilly sensations, thinks no fever. Steady loss of weight. The skin and mucous membranes showed a distinct pallor.

Laboratory tests showed the urine to be acid, specific gravity 1,012, albumin 4 plus, no sugar; many pus cells, a few erythrocytes. B.P. 140/80, Hb. 53 per cent, R.B.C. 2,900,000; W.B.C. 14,000; N.P.N. 46.1; bl. sug. 117; urea nit. 28.28, urea 60.52, uric acid 5.16. Two-hour intramuscular P.S.P.: First hour, 12 per cent, second hour 20 per cent. Daily temperature as high as 102° F.

Physical Examination was without special findings except for the presence of a large mass filling each flank. These were interpreted as enlarged kidneys; they were rather tender on palpation, and the ureters were tender on palpation over the region of the pelvic brim and in the broad ligaments. The left ureter seemed infiltrated in its broad ligament portion, but did not feel like a tuberculous ureter. Careful examination of the urine for tubercle bacilli was negative.

The patient was so ill that we were cautious about active investigations, and, during the month she was in the hospital, we catheterized the right kidney twice, finding it the seat of a colon bacillus pyonephrosis, and the left kidney once, this being the seat of a 40 cc. hydronephrosis infected by the *Staphylococcus albus*. With our small bulbs we got fairly definite evidence of ureteral stricture. Ten days after the last ureteral treatment, and after several days of seeming improvement, the patient suddenly developed coma and died within 24 hours.

Autopsy.—Church Home No. 246: Revealed bilateral congenital cystic kidney, a condition which had not been considered in our clinical investigation, although the urograms showed widespread dilated calices. (Roentgenograms destroyed after the Cleveland Clinic fire.) It had been considered by the staffs at the Frederick Hospital and at the Church Home that the right kidney was decidedly larger than the left. At autopsy the right kidney weighed 720 Gm. and the left, which had a complete reduplication of the pelvis and ureter, weighed 1,700 Gm. The ureters were described as appearing normal and were not saved. Other autopsy findings, probably contributory to death, were edema of brain, bilateral, catarrhal, purulent bronchitis, right bronchial pneumonia, and fatty degeneration of liver with focal necrosis.

Case 3.—*Synopsis: Interstitial cystitis. Infected hydronephrosis. Bilateral, dilated ureters, apparently from peri-ureteritis in bladder walls. Cholelithiasis. Rectocele. Diagnosis of congenital cystic kidney made only after autopsy on Case 2, and comparison of the roentgenograms on Cases 2 and 3. Great improvement in bladder symptoms and in general health after ureteral dilatation. Death three months later.*

Mrs. C. G., age 57, was seen in the Johns Hopkins Hospital dispensary, January 21, 1928. When six months pregnant with her only child, 30 years ago, she began having intense bladder symptoms and had to wear a rubber urinal because of incontinence. The child, weighing 1.5 pounds, was born at eight months. Ever since, there has been much bladder frequency and pain and occasional leakage. One year after the baby's birth, patient was operated upon for ovarian tumor, and for a year bladder irrigations were given, with some improvement. The surgeon reported finding one side of her bladder much thickened. Synchronous with the bladder symptoms, there has been much indigestion, and about twice a year she has an acute right "kidney colic" and indigestion. A plain roentgenogram showed a large gallstone, but there was no tenderness in the gallbladder region, and the patient's attacks of indigestion seemed associated with the urinary tract symptoms.

Cystoscopy revealed an apparent widespread interstitial cystitis involving chiefly the left half of the bladder, and in the vertex were tiny lesions suggestive of elusive ulcers. The kidneys showed irregularly dilated pelves and calices, the right side holding 41 cc. and the left 16 cc. Both sides were infected. Each ureteral lumen was about 1 cm. in diameter from the kidney to the region of the bladder wall; we considered this dilatation as due to the thickened bladder walls rather than to true stricture. The half-hour intramuscular P.S.P. showed:

	Ap. T.	Amt.	Per Cent
Right kidney (cath.)	7 min.	50 cc.	5 ?
Left kidney (blad.)	10 min.	50 cc.	5 ?

The outline of the left kidney seemed considerably enlarged and nodular, and we seriously considered the possibility of a renal tumor. While dilating the ureterovesical regions at ten-day intervals, we had the autopsy on Case 2 at the Church Home, and the similarity of the irregular renal pelvis shadows in the two patients drew our attention to the probability that this patient was also a victim of congenital cystic kidney.

The patient's symptoms and the appearance of the bladder steadily improved, until a dilatation of No. 17 Fr. was reached, when the patient was dismissed with advice to her physician in North Carolina that she might later need a series of ureteral treatments; and, in view of her low renal function and absence of gallbladder symptoms, we advised against a gallbladder operation unless it became imperative.

A recent report from a relative says that the patient died about three months after her return home. The immediate cause of death was not mentioned. This report was rather surprising, for the patient was able to board near the hospital and have her treatments in the dispensary, and the apparent gain in well-being and the rapid improvement in her bladder condition seemed to promise a new lease on life. The most adverse clinical finding was the very low functional value; unfortunately, the two-hour test was not repeated after the ureteral dilatations.

Case 4.—Mrs. Z. B., age 42, was seen in a state of coma at her home, May 24, 1931. According to her husband she had complained 48 hours previously of a severe headache. The following morning she had seemed well, but that evening she again complained of severe headache and seemed to have become clouded mentally. The next day, the patient had been in coma continuously. When examined, she seemed to be in a quiet sleep. The breathing was heavy but not stertorous. No odor was detected, suggestive of uremia or acidosis. The color was excellent. The pulse was strong and regular but slow, between 50 and 60. Pinching the arms and legs elicited normal reaction. Brief questioning seemed to point to a renal origin for the coma. The patient had a daughter in good health, 19 years of age. Later, there had been two spontaneous abortions at about the third or fourth month, said to have been due to low blood pressure. The tension was said to have altered from time to time between very high and very low levels. Five months previously, there had been an attack similar to the present one, lasting for two days, which was ushered in with severe headache. The patient was sent to the Church Home where the following notes were made: T. 101° F., B.P. 200/85; W.B.C. 14,400, Hb. 104, N.P.N. 36.6 mg. per cent, bl. sug. 266 mg. per cent. Eyegrounds showed marked tortuosity of the vessels, no hemorrhage. The patient had not voided for 24 hours and the bladder was catheterized of a small amount of urine which showed: Acid, a few R.B.C., a few granular casts, no bile, sugar +++, albumin ++, acetone +, diacetic acid +. While obtaining the blood chemistry specimen, an intravenous infusion was given of 600 cc. of 5 per cent glucose, and on finding the high sugar content of the blood and urine, there were given during the night three doses of insulin, each of 20 units. The following morning the blood chemistry showed: N.P.N. 41.4 mg. per cent and sugar 122 mg. per cent. The patient died 14 hours after admission, and permission for a limited autopsy was obtained.

Autopsy.—Through a small midline incision in the upper abdomen, the abdominal and pelvic organs were found to be apparently normal. Adrenals normal on inspection. The kidneys were removed. The left kidney weighed 390 mg., and measured 16x7x5 cm. Entire organ studded with various sized, thin-walled cysts filled with fluid varying in color from clear yellow to opaque and dark brown or black. Largest cyst measured 3.5 cm. in diameter. The right kidney weighed 460 mg. and measured 16x8x5 cm. The lower pole consisted of one large thin-walled cyst filled with clear fluid and measuring 7 cm. in diameter. The remainder of the kidney was studded with irregular small cysts,

apparently less numerous than those in the left kidney. No note was made on inspection of the ureters.

Case 5.—*Synopsis: Bilateral congenital cystic kidney, in which the true diagnosis was delayed for five years after the first hospital admission, and then made only by an exploratory abdominal operation. The operation of partial nephrectomy probably resulted in definite benefit to the patient's renal condition, although, apparently, most of the symptoms had been due to the pathologic conditions found in the ureters. Symptoms relieved and patient's general health vastly improved by ureteral dilatations, inadequately followed during the past six years. Removal of infected tonsils and care of bad teeth in the past year.*

Mrs. O. W. L., age 20 when I first saw her, in 1932. In March, 1927, at age 15, she was admitted to the Surgical Department because of pain in the right lower quadrant. Leukocyte count 12,300. At operation, the appendix contained gas and fecal material and it was considered the site of an acute inflammation. The pathologic diagnosis was "chronic appendicitis." Urine was normal at this visit. Two years later, the patient entered the cystoscopic dispensary, complaining that she had continued to have attacks of pain in the lower right quadrant similar to those experienced before the appendix operation. Abdominal examination revealed enlargement and tenderness of both kidneys and tenderness on palpation over the right ureter at the pelvic brim. Urinalysis: Pus, and culture of colon bacillus. Two-hour P.S.P.: First hour, 75 per cent, second hour, 5 per cent. Plain roentgenogram negative for stone; right urogram, right kidney much enlarged, pelvis and calices dilated; urine, pus and culture of colon bacillus. Diagnosis: Infected hydronephrosis, right; cystitis, chronic. Treatment: Dilatation of right ureter up to No. 14 Fr. No cultures before patient was dismissed.

I saw the patient for the first time, April 5, 1932. She reported good health after her last cystoscopic treatments, in 1929, up until ten days before admission, when she was taken suddenly with a severe pain, this time in the left upper quadrant, radiating downward to the groin. With the attacks, there had been frequency and burning on voiding. Occasionally there had been some pain in the right lower quadrant "where my appendix was." The patient had married since her last visit, and in January, 1932, there was an early miscarriage without known cause.

Physical Examination.—Abdomen appears normal. On palpation a large mass occupies the left upper quadrant, the lower pole resting on the transumbilical line, and descending freely on inspiration. It is slightly tender, and it feels rather more firm than a normal kidney, suggesting a chronic perinephritic mass, but its free mobility is against this view. No nodules distinguished. Left ureter at the pelvic brim is not tender, but pressure causes desire to void. Right kidney easily palpable over its lower third on deep inspiration, seems of about normal size and consistency, freely movable, not tender. Right ureter at the pelvic brim not tender, but pressure causes desire to void. Appendix region, some gas on pressure, no tenderness. Liver border apparently outlined in the gallbladder region, no mass, no tenderness. Dragging over sigmoid not tender. Genitalia normal size and position, freely movable. Left ureter as it crosses through the broad ligament feels like a fine wire about No. 8 size. One can snap it over the tip of the finger. This maneuver is painful and causes desire to void, and reminds patient of a prolapsus sensation she has noticed since her miscarriage four months ago. Right ureter not outlined, palpation elicits tenderness, a desire to void, and a sensation of prolapsus of the pelvic organs. The house staff had made preliminary studies (Figs. 1, 2 and 3). The urine from the left kidney showed many leukocytes, and the culture yielded *Staphylococcus aureus*. With the catheter in the left ureter, the half-hour P.S.P. showed:

	Ap. T.	Amt.	Per Cent
Left kidney (cath.).....	3 min.	65 cc.	30
Right kidney (blad.).....	3 min.	110 cc.	30

Two days later with the catheter in the right side, the urine showed a rare leukocyte and negative culture. The half-hour P.S.P. showed:

	Ap. T.	Amt.	Per Cent
Right kidney (cath.)	5 min.	175 cc.	40
Left kidney (blad.)	14 min.	150 cc.	25

The delayed appearance time and lower output on the left side may have been due to the temporary reduction in work following edema of the left ureter after the trauma of examination two days previously. A small bulb on the catheter in the examination of each ureter gave a "hang" in the broad ligament region.

Clinical Impressions.—"Patient undoubtedly has bilateral ureteral strictures as evidenced by the history during the past three years, and by the present physical findings. While the mass in the flank feels much like an enlarged kidney, or like an infiltration

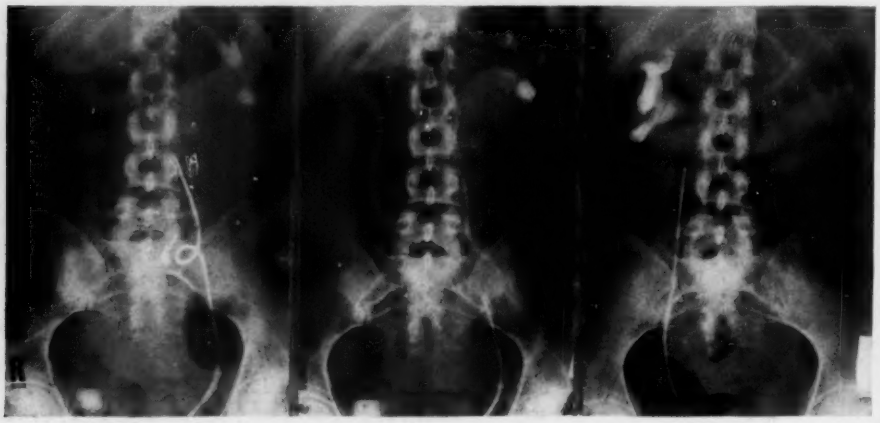

FIG. 1. FIG. 2. FIG. 3.

FIG. 1.—Case 5: The plain roentgenogram, preceding this urogam, showed apparent absence of stone, and, as in this film, it revealed the tip of the catheter stopped at the level of the third lumbar interspace, and the apparent loop of the catheter near the pelvic brim. Note the large, dense mass filling the left flank, the large stomach shadow blurring the upper pole of the left kidney, the greater curvature of the stomach crowded upward and to the right by the mass. The inner border of the mass covers the left portion of the lumbar vertebrae II, III and IV. The tip of the catheter stopped apparently by lateral pressure of the mass. No NaI above the catheter tip except in two of the calices. Reflux of NaI into pelvic ureter and bladder.

FIG. 2.—Case 5: Catheter withdrawn until tip rests at about the pelvic brim, lower half of abdominal ureter filled up to the region where catheter tip was stopped on introduction, reflux of NaI beside pelvic portion of catheter with filling defect in about region of hypogastric node, and another about 2 cm. above the ureteral orifice. Reflux to bladder. Filling defect from third lumbar interspace to kidney, with slight shadow of the pelvis and what appear to be clubbed upper and lower calices.

FIG. 3.—Case 5: Right urogram, showing the catheter tip at a point opposite the third lumbar interspace. Note the slight reflux of NaI in the region of the pelvic brim and again in the midportion of the pelvis down to the broad ligament region. Without the bulb, which "hung" in the broad ligament region, one would have to interpret this roentgenogram as showing a normal ureter. The reading of the pelvis was that of a slight hydronephrosis. Subsequent events, however, reveal that the suggestively splayed character of the calices and the increased shadow of the cortex should have led us to suspect that we were dealing with a congenital cystic kidney.

of the perirenal fat, yet the clinical history, the comparatively free mobility of the mass, and the normal leukocyte count, do not favor the diagnosis of perinephritis. The presence of stricture could account for the patient's recent symptoms. Should have a barium enema and an intravenous series as further aids in the diagnosis" (See Figs. 4 and 5).

Preoperative Diagnosis.—Multiple bilateral ureteral strictures, bilateral hydronephrosis, tumor in left flank of renal, splenic, pancreatic, or intestinal origin. With the uncertainty of the origin of the tumor mass, we determined upon a left rectus incision, in order to give easy access to either an intra- or extraperitoneal mass.

Operation.—April 12, 1932: Dr. Gerald Hurd, assisted by Doctor Hunner. A short

exploratory incision along the white line of the left rectus muscle. It was difficult to separate the peritoneum from the deep fascia along the white line, so incision was made through the peritoneum. This revealed a large, multicystic, extraperitoneal mass. Palpation of the right renal region revealed an enlarged nodular mass about twice the volume of a normal kidney. The exploratory incision was enlarged, severing the eleventh and twelfth intercostal nerves and vessels, and the posterior peritoneum was incised and easily stripped forward off the mass. The upper ureter was exposed for a distance of about 8 cm., and except for slight dilatation and thickening of its walls, it appeared normal. The extrarenal portion of the pelvis was rather thick-walled. The upper pole of the kidney was studded with cysts but retained a fairly normal outline and it merged rather abruptly with the much enlarged lower half of the kidney. The half-hour differential P.S.P. had shown about an equal output from each kidney, making it seem extremely unwise to sacrifice the entire kidney. We therefore lifted the lower portion

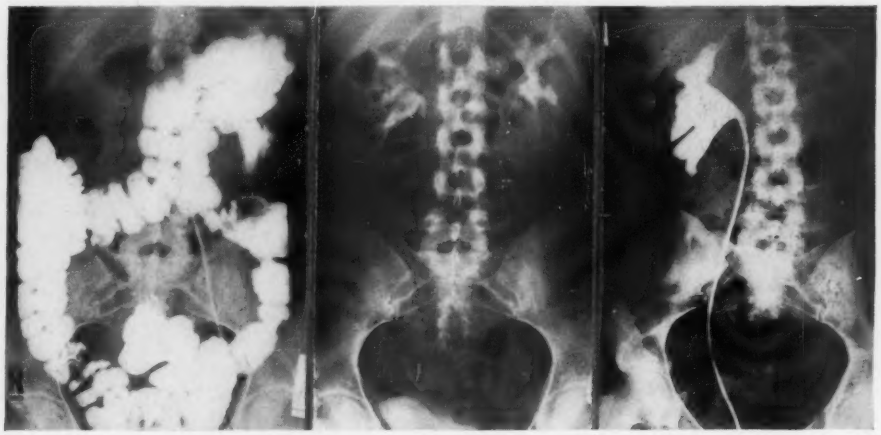

FIG. 4. FIG. 5. FIG. 6.

FIG. 4.—Case 5: Barium enema. This was taken after passing a No. 8 whistle-tip radiopaque catheter without bulb well over into the kidney pelvis, and combining a urogram with the barium film. This suggests a low cecum, the hepatic flexure displaced downward, the splenic flexure displaced upward and medianward, a questionable filling defect at the beginning of the sigmoid. The surprising finding with the better filled renal pelvis is the large dilated set of lower calices which have not shown in previous films, and which apparently are only slightly deformed by pressure of the large mass in the left flank.

FIG. 5.—Case 5: Intravenous urogram. Note on the left side the spider-leg shadows of the lower calices, the absence of any shadow in the left ureter. Note on the right side a good shadow in the upper ureter, and again in the lower pelvic ureter, with filling defects in the region of the hypogastric nodes, and again in the broad ligament region about 3 cm. above the ureteral orifice. Considerable NaI in bladder in this 30-minute film.

FIG. 6.—Case 5: February 9, 1938. Compare with Figure 3, taken six years previously. Great increase in size of pelvis, probably due to increase in size of cysts and to back-pressure by the stricture.

of the kidney out of the wound. This mass was irregularly globular and measured 10 to 12 cm. in diameter. From this we resected a triangular pyriform mass measuring 6 to 8 cm. on each face. The edges of the resected portion were approximated with a No. 0 plain catgut in a running lock-stitch suture, one area, about 3 cm. long, being left open for temporary drainage. We considered the possibility of this creating a permanent fistula, but it granulated over promptly. After carefully returning the kidney to its normal position, three small cigarette drains were carried down to the open area of the cortex. As in all conservative operations upon the kidney, the foot of the bed was elevated 18 inches for 24 hours, in order to insure a good position for the kidney and upper ureter. The patient was discharged on the twenty-eighth postoperative day. She was not seen again until five years later.

On June 10, 1937, the patient reported having had good health until an attack of influenza the previous winter. Following this, pain gradually developed in both renal

regions and was more severe on the left side. For the previous week the pain had been more severe and was accompanied by nausea. Doctor Everett found that she had bilateral colon bacillus pyelitis, and after several dilatations on either side there was marked relief. At the first visit, a half-hour intravenous P.S.P. yielded:

	Ap. T.	Amt.	Per Cent
Left kidney (cath.).....	10 min.	275 cc.	30
Right kidney (blad.).....	10 min.	75 cc.	15

This seemed to verify the value of our conservative operation on the left side, and to indicate that the right kidney had deteriorated in its working capacity during the preceding five years. This deterioration may chiefly have been due to increase in the size and pressure of the multiple cysts, and, if so, it probably was permanent. On the

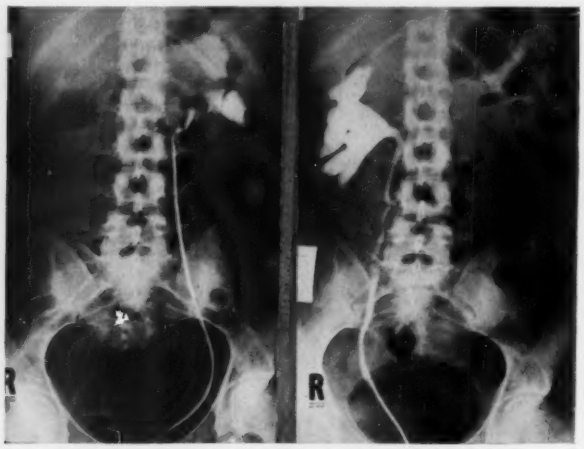

FIG. 7. FIG. 8.

FIG. 7.—Case 5: Note absence of large shadow formerly filling left flank. Again we see the catheter tip obstructed in approximately the same region as in Figure 1. This obstruction may have been caused by a stricture stopping the tip or distal shoulder of the bulb, or a kink stopping the tip. It appears that there is a very narrow area just at the tip and a sharp angulation just above this narrow area. On subsequent treatments we have passed Nos. 10 and 12 bougies, with the sloping end reaching full size 5 cm. back of the tip, entirely over into the kidney. We then passed the No. 9 whistle-tip catheter with a No. 12 Fr. bulb over into the kidney and, on withdrawal, obtained a strong "hang" at this area, 26 cm. from the external urethral orifice, and "hangs" in the region of the hypogastric nodes and in the broad ligament.

FIG. 8.—Case 5: November 17, 1938. Shows about the same size pelvis as Figure 6, taken February 9, 1938. The ureterogram shows a sharp angulation opposite the fourth lumbar, where we have frequently met an obstruction to the catheter tip on introduction. However, bulbs up to No. 15 Fr. show "hangs" only in the region of the hypogastric nodes and in the broad ligament, where filling defects are seen in the film. The left ureter has given more trouble because of the frequent failure to get through the high stricture (Fig. 7), and a No. 12 Fr. has been the highest dilatation reached.

other hand, the deterioration may have been due, in considerable degree, to the stasis of contracting ureteral stricture, and, if so, the reestablishment of good drainage would result in improvement of the P.S.P. output. The patient returned eight months later, February 6, 1938, having been well until February 2, 1938, when she began to have a nagging feeling in the region of the navel, a marked hematuria, and a constant desire to void. The hematuria continued until the day of admission, when severe colicky pains began in the left upper quadrant. The clinical findings were: B.P. 165/100, Hb. 85 per cent, N.P.N. 32, CO_2 54; two-hour P.S.P.: First half-hour, 200 cc., 40 per cent; second half-hour, 400 cc., 15 per cent; second hour, 720 cc., 12 per cent, total 67 per cent.

I saw the patient, February 9, 1938. After the first day in the hospital there had been some pain after meals but no renal colic. She had not again seen blood in the urine. A catheterized bladder specimen, centrifuged, showed in the h.p.f., 3 to 4 R.B.C.;

10 to 12 W.B.C.; rod bacilli, and an occasional hyaline cast. The left kidney had been much reduced in size after the operation. The lower pole reached the navel line and the kidney felt slightly enlarged, not tender. The left ureter pelvic brim region was very tender, and pressure caused a nauseated feeling and a desire to void, and the patient said this was the seat of her chief pain. The right kidney was larger than before the operation on the left side, nearly six years previously. The lower pole extended slightly below the navel line, and there was slight tenderness.

The right ureter (Fig. 6) took a No. 9 pointed-tip, radiopaque catheter, with spiral wax-tip and small bulb near the tip, encountering three rather dense obstruction areas going in, one of these being near the kidney. Free flow, as if some renal retention. About 30 cc. of urine came out in a steady stream. The right kidney specimen reported as containing no R.B.C., W.B.C., casts or organisms, but a slant agar culture developed a heavy growth of *B. coli*. On withdrawal, there was no "hang" of the scant 12 Fr. bulb in the area near the kidney, which had firmly obstructed the catheter on entrance, but there were two definite "hangs" in the lower pelvic ureter. No scratch marks on tip or bulb. The tip had been in originally 35.5 cm. above the external urethral orifice. Figure 6 shows that the kidney pelvis had more than doubled in size during the six years since Figure 3 was taken. Part of this increase in size, no doubt, was due to the general increase in size of the kidney, but some of it may have been due to the stasis caused by the strictures. On the following day urograms were obtained on the left side, only one of which is reproduced (Fig. 7).

The patient was followed during the summer of 1938, and the right ureter was satisfactorily kept at a dilatation of No. 15 Fr.

A recent half-hour P.S.P. showed:

	Ap. T.	Amt.	Per Cent
Right kidney (blad.).....	5 min.	120 cc.	30
Left kidney (cath.).....	5 min.	75 cc.	15

This, compared with the half-hour differential test, made June 10, 1937, seems to show a considerable improvement on the right side since good drainage has been sustained, while the left side, with the difficulties of drainage, has deteriorated.

June 10, 1937: The patient reported good health for nearly five years, and then the development of her former symptoms after an attack of influenza. This led to the quest for possible foci of infection, and diseased tonsils and teeth were found. The teeth were attended to, but the tonsils were not removed until April, 1938. With the more systematic treatment during the past few months, the patient usually reports freedom from all symptoms, and she seems to be leading the normal life of a hard-working housewife.

Case 6.—*Synopsis: Bilateral congenital cystic kidneys with chief symptoms referred to the gastro-intestinal tract. Cholecystectomy, three years previously, without apparent benefit. Preoperative Diagnosis: Tumor of left kidney and possibly of right, bilateral ureteral stricture. Occasional ureteral dilatations during the past six years, the patient enjoying comparatively normal health.*

Mrs. M. P., age 29, was admitted to the hospital, September 20, 1932, complaining that four months previously she had discovered a mass in the left upper quadrant. This was only slightly painful, but it made her nervous and caused pain in the cardiac and left axillary regions. Steady loss of weight. No hematuria. Soon after marriage, 12 years previously, she had an abortion of a one-month pregnancy, and soon had a hystero-salpingectomy for pus tubes. Three years ago, developed indigestion and mucous colitis for which cholecystectomy was performed, without apparent benefit. Last bad attack of colitis about one month ago.

Physical Examination revealed a rounded, nodular mass, easily palpable high in the left flank, projecting from beneath the left costal margin. This descended freely on deep

breathing. The patient was admitted on the Medical Service, and both Doctors Longcope and Hamman thought there was a tumor of the left kidney, and possibly of the right kidney also. Roentgenograms of the chest were negative. Wassermann negative. B.P. 116/74, W.B.C. 5,400, Hb. 100 per cent. Dr. Gerald Hurd, resident gynecologist, found that there was bilateral ureteral stricture. A half-hour intravenous P.S.P. showed:

	Ap. T.	Amt.	Per Cent
Right kidney (cath.)	3 min.	75 cc.	35
Left kidney (blad.)	3 min.	25 cc.	25

A few pus cells in the urine from each kidney; cultures negative. Figures 9 and 10 show that the urograms were not particularly helpful in the diagnosis.

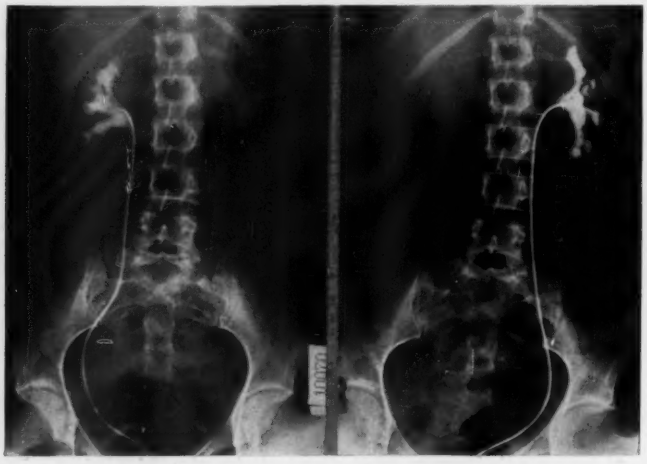

FIG. 9. FIG. 10.

FIGS. 9 and 10.—Case 6: The kidneys show a tendency toward the trifid type, the pelves being smaller than normal, and some of the calices possibly showing a slight tendency to dilatation; and, after the findings at operation, one might argue that there is a suggestion of the splayed form of calix.

Operation.—October 6, 1932: Doctor Hurd, assisted by Doctor Hunner. Lumbar, extraperitoneal exploration of left kidney. The kidney was found to be about three times normal size, and filled with numerous small cysts, measuring from 1 to 3 cm. in diameter. A small biopsy section was excised, and the renal wound was closed with a mattress suture of plain No. 1 catgut. The lumbar wound was closed in layers, and the foot of the bed was elevated 18 inches for the first 24 hours to favor a good permanent position for the kidney. The patient was discharged in good condition on the sixteenth postoperative day. She was advised to place herself under the care of Dr. Frederick Wright, of Hanover, Pa., for further dilatation of the ureters. She consulted Doctor Wright four months after operation, January 30, 1933, complaining of moderate pain in both renal regions and of frequency of voiding. A catheterized specimen of bladder urine was cloudy, yellow, acid, specific gravity 1,002, sugar none, albumin 2 plus, no acetone or diacetic, a few pus cells. B.P. 125/70, Hb. 79 per cent, R.B.C. 4,288,000; W.B.C. 4,800. Between January and November, 1933, Doctor Wright treated each ureter on four occasions, dilating the strictures up to a No. 14 Fr. The patient returned five years later, February, 1938, reporting that her health had been good until quite recently when she again began to have aching in the renal regions, frequency of voiding at night, and gastro-intestinal symptoms. The clinical investigation showed: Urine amber, clear, acid, specific gravity 1,020, albumin one plus, no sugar, acetone or diacetic acid. An occasional pus cell. Blood urea 13.2, N.P.N. 27.4, Hb.

90 per cent, R.B.C. 4,568,000; W.B.C. 7,300. Two-hour intravenous P.S.P.: First hour, 305 cc., 40 per cent; second hour, 120 cc., 30 per cent. The ureters were again dilated up to No. 14 Fr., and a recent report says the patient has gained ten pounds in weight and has had good general health, but recently has had moderate pain at times in the region of the left kidney. Doctor Wright plans to have her return for a series of treatments that will carry her ureters to a No. 15 or 16 Fr. dilatation.

Case 7.—Figures 11 and 12 are roentgenograms forwarded, February 10, 1933, by Dr. Etley P. Smith, of Fairmont, W. Va., who suspected he was dealing with a case of congenital cystic kidney. A Polish coal-miner, age 37, had been sent to the hospital because of hematuria, which followed a blow over the right flank the previous day. The family history and the patient's past history were negative, except for a gradual loss of 20 pounds in weight during the past two years.

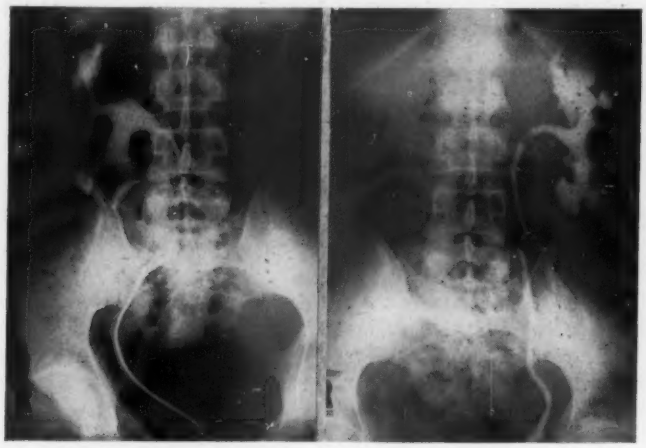

FIG. 11. FIG. 12.

FIG. 11.—Shows the right ureter crowded over to the midline by the large renal mass, narrowing of the upper abdominal ureter (probably by pressure), slight dilatation of the pelvic ureter from the pelvic brim to a point about 4 or 5 cm. above the bladder. Probably one or more stricture areas in the pelvic ureter.

FIG. 12.—Shows a fine line of ureteral lumen in its vesical 2 cm. From this area to the kidney, the left ureteral lumen is slightly dilated except at a point opposite the fourth lumbar interspace. Here there is an angulation and possibly a stricture (to be tested with a bulb). Probably definite stricture of vesical portion of left ureter.

Physical Examination showed apparent slight anemia, rather flabby musculature, and in the right kidney region a tumor mass, extending down to the pelvic brim, which was movable on respiration, and slightly tender on palpation. There were no marks of trauma on the chest or abdominal walls. Cystoscopy showed a normal urethra and bladder, and bloody urine spurting from the right ureteral os. The urine from the bladder and that from each kidney were essentially alike, showing acid, a heavy trace of albumin, no sugar, W.B.C., some clumps, R.B.C. (more from right kidney), an occasional hyaline cast, and a culture of a gram-negative bacillus. There was no temperature elevation. Blood N.P.N. 43. Half-hour P.S.P., intravenous, showed: Right, 12 per cent; left, 20 per cent. From a study of the urograms I confirmed the diagnosis of congenital cystic kidney, and added the diagnosis of probable bilateral ureteral stricture.

A report from Doctor Smith, November 15, 1937, four and one-half years later, states: "During February, March and April of 1933, I dilated the ureters up to No. 14 Fr. I used bulbed catheters and had considerable difficulty especially on the left side. He continued his mining work, and two months after the dilatation was finished he seemed to be in fairly good condition, with the exception that he was having some

pain and a feeling of fulness over the right kidney. His urine was practically clear, but final cultures were not taken. The two enlarged kidneys remained of about the same size. He was definitely improved after the ureteral dilatation, but on attempting to trace him recently one of his friends said he had removed to New York State, and I failed to learn his address."

Case 8.—H. I. S., a male child, three weeks old, was referred, July 6, 1934, by Dr. Thomas F. Daniels. The child had been delivered by Dr. William Millea, who reported a long, slow labor due to enlargement of the child's abdomen by bilateral congenital cystic kidneys. The child was large, well nourished, and of good color. The head seemed somewhat enlarged, and the fontanelles were wide, but the child seemed normally alert and bright. The transverse diameter of the upper abdomen was much increased by the presence of a large, solid-feeling, nodular mass occupying the upper portion of each flank. The mass in the left flank seemed somewhat the larger, and its lower pole reached a line halfway between the navel and the symphysis.

Inasmuch as the child seemed in good health, the mother was advised to do nothing unless it developed special symptoms. At six months of age the child was admitted to another hospital with the history that he had been in apparently normal health until the day before admission, when he was suddenly taken with repeated vomiting and diarrhea, the stools soon becoming bloody. These symptoms persisted until death 48 hours after onset of the attack. Autopsy was not obtained. The diagnosis was hydrocephalus, congenital cystic kidneys, intussusception of bowels(?).

Case 9.—*Synopsis: Bilateral congenital cystic kidneys. Bilateral ureteral stricture. Small renal calculus, left. Large cyst lower pole right kidney, ruptured and drained spontaneously after first visit. Subacute colon bacillus pyelitis, right, cleared spontaneously after first visit, but was present again on fourth visit, three years later. Chronic pyelitis left kidney, improved, but colon bacillus persists, probably due to presence of calculus. Five hospital visits in four years, resulting in great gain in weight, and practical absence of symptoms.*

Mrs. I. S., age 39, seen in consultation with Doctor Everett, September 9, 1934. Complaint: Dysuria, frequency, pain and fulness in right side of abdomen. Para two, 17 and 13 years of age. Labors normal and spontaneous, lacerations with first labor and the first puerperium complicated by fever. G.I.: No important symptoms. P.I.: During the last two to three months, occasional brief periods of dysuria and frequency. Three weeks ago, during an automobile ride, the patient did not find it convenient to void for about two hours after she first felt the desire. When she did void there was considerable pain, and the next day she had rather marked frequency and burning. She was placed on forced fluids and caprokol, and the bladder symptoms gradually abated somewhat, but a few days later there was pain and discomfort in the right side of the abdomen and slight fever. One week ago, patient was taken to the hospital and cystoscoped and a catheter was left in the right ureter for two days. This catheter is said to have drained pus, and the pain was somewhat relieved. Exploratory operation on the right kidney was advised. Intravenous urograms were taken and are said to have shown active secretion on both sides; also a definite shadow of stone in the left kidney, and a shadow vaguely suggestive of a stone in the right kidney.

Physical Examination.—Doctor Everett: The abdomen was found to be soft and flat except for the presence of a large, spherical mass lying in the right upper quadrant, and apparently coming from beneath the costal margin and extending back into the posterior flank and reaching well down to the level of the navel. The left kidney was not felt and tenderness was not elicited in this region. There was slight tenderness on palpation over each pelvic brim region near the spine. Liver and spleen not palpable. Doctor Everett's further studies led him to the conclusion that the patient had bilateral polycystic kidneys, with a subacute colon bacillus pyelitis on the right side and a chronic, colon bacillus pyelitis on the left side.

With ureteral dilatations at ten-day intervals, accompanied by pelvic lavage with normal salt solution and followed by lavage with a small amount of silver nitrate solution 1:1,000, the patient made steady improvement and was dismissed at the end of two months.

The patient returned one year later in greatly improved general health. She reported occasional slight pain in the region of each kidney, but there were no bladder symptoms, and she had not had fever. All evidence of infection in the right kidney had disappeared but the left kidney still carried a mild colon bacillus infection, probably encouraged by the presence of the small stone trapped in an upper calix (Fig. 14).

April, 1936: The patient seemed in such excellent condition in every way that cystoscopic examination was not made. The catheterized bladder urine showed only one or two pus cells. A two-hour P.S.P. showed: First half-hour, 400 cc., 20 per cent; second

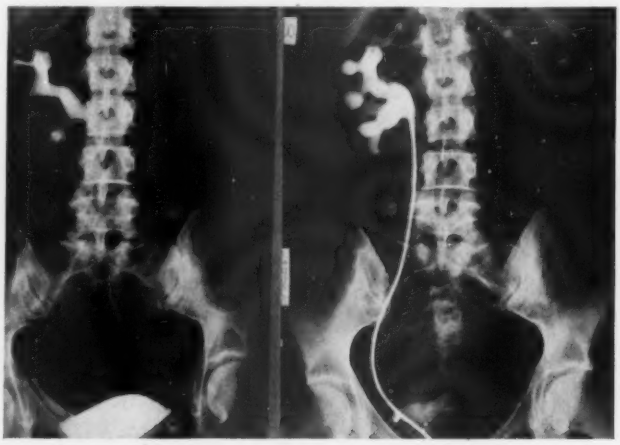

FIG. 13. FIG. 14.

FIG. 13.—Shows a small round stone, about 1 cm. in diameter, in one of the upper calices of the left kidney. The right kidney apparently contains a large cyst in its lower pole which displaces the ureteral catheter medianward to the midline of the shadow of the lumbar vertebrae. Doctor Everett thought the pressure of this large cyst on the upper abdominal ureter might have caused the recent acute attack of pyelitis on the right. While both ureters were slightly dilated from the kidney to the broad ligament region, he got no "hang" of a wax bulb on the right side until later treatments had reached a dilatation of 5.6 Mm., when there was a "hang" of the bulb at 27 cm. above the external urethral orifice and another "hang" near the bladder. On the left side the increasing sized bulbs hung at 9 cm. from the outside, and with the 5.6 Mm. bulb there was also a "hang" at 27 cm.

FIG. 14.—Shows that the large cyst in the lower pole of the right kidney had drained spontaneously, and that the ureter was no longer displaced so far medianward, and the enlarged calices presented a vastly different picture.

half-hour, 350 cc., 10 per cent; second hour, 500 cc., 25 per cent, a total of 1,250 cc., 55 per cent. The patient had gained 25 pounds since her previous visit in September, 1935. There had been no ureteral dilatations since the first visit, in 1934.

April, 1937: Had apparently been in excellent physical condition, but, for about a month, she had been complaining of pain in the left kidney region and had had some light chills and fever; there were no bladder symptoms associated with this attack. She had been feeling better for the two weeks before admission to the hospital. Doctor Everett found, in the left kidney specimen, 15 to 20 W.B.C., and there was still a colon bacillus infection. The half-hour intravenous P.S.P. showed a three-minute appearance time, and a 22 per cent secretion from each kidney. The right kidney had again picked up a mild colon bacillus infection and the urine showed about 5 to 15 W.B.C. Ammonium mandelate was given, which seemed to reduce the amount of pus but did not entirely do away with the colon bacillus, probably because of the stone in the left kidney. Her general condition was so good that Doctor Everett did not attempt further ureteral dilatations.

November, 1938, four years after the first treatments: Patient reported excellent health. B.P. 138/92, Hb. 82 per cent, N.P.N. 28.5. The two-hour intravenous P.S.P. showed a total of 62 per cent; 35 per cent in the first half-hour. A differential half-hour P.S.P. showed 20 per cent from each kidney. Roentgenograms taken at this time are shown in Figures 15 and 16.

Case 10.—*Synopsis: Bilateral congenital cystic kidney. Bilateral ureteral stricture. Symptoms suggestive of renal disturbance since age 14. Diagnosis of floating right kidney at age 24. Diagnosis of cystic kidneys and ureteral stricture at age 34.*

Miss S. G., age 34, referred, September 12, 1934, by Dr. Herbert Traut, who had made a careful investigation at the New York Hospital, and concluded that the patient had hypertension, reduced renal function, nitrogenous retention, and bilateral hydronephrosis, "all probably associated with bilateral ureteral stricture." Some of Doctor Traut's findings were as follows: Urine from bladder, a few R.B.C.; Hb. 100 per cent,

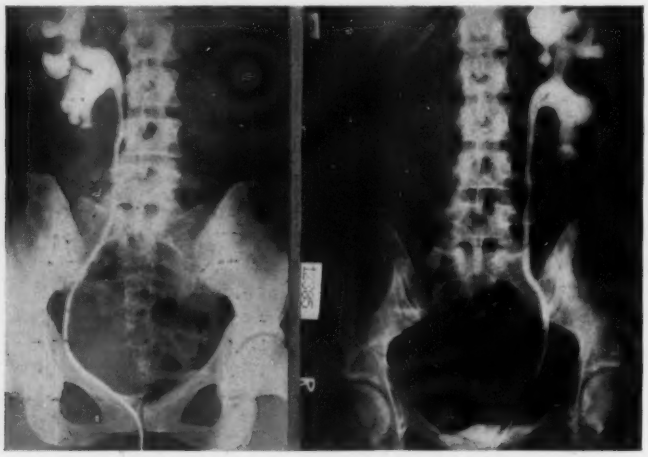

FIG. 15. FIG. 16.

FIG. 15.—Case 9: Shows a relative narrowing of the right ureter just below the pelvi-ureteral junction, and a slight dilatation of the ureter in the broad ligament region down to the ureteral os (compare Fig. 13).

FIG. 16.—Case 9: Shows the tiny calix with narrow neck, depending from the upper group of clubbed calices. Other films have shown that the calculus resides in this tiny calix. With the catheter withdrawn until its tip is just within the ureteral os, there is seen good filling of the upper tract with moderate dilatation of the left ureter, and areas of comparative narrowing opposite the third and fourth lumbar interspaces, and a filling defect in the broad ligament region.

W.B.C. 10,250; blood chemistry: sugar 77, CO_2 comb. power 56, chlorides 469, N.P.N. 45.8. Of two half-hour intravenous P.S.P.'s, the second, and higher one, showed:

	Ap. T.	Amt.	Per Cent
Right kidney (cath.)	4 min.	190 cc.	18
Left kidney (blad.)	6 min.	120 cc.	10

Doctor Traut forwarded urograms of each side to me, from which I concluded that the vertical spread of the pelves, and splayed character of some of the calices, strongly suggested congenital cystic kidney. Some of the points in the patient's history suggesting the probability of renal disease, and especially of ureteral stricture, were as follows: The menstrual periods began at age 18, but for four years before the onset, there had been monthly attacks of extremely severe headaches, dizziness, nausea and vomiting confining the patient in bed three or four days. The menses have been of the 28-day type, with about seven days of free flow. Not incapacitated from work during

this time but always has headache, and pain in the right ovarian region and across the lumbar regions.

The first attack, directly pointing to renal trouble, occurred 11 years ago, with a sudden "kidney colic" on the left side accompanied by tenesmus and frequency and the passage of blood. The severe symptoms lasted only about one hour but she was in bed for one week. Ten years ago, had a similar attack of "kidney colic" on the right side, together with hematuria. Was in bed two weeks, and then had two cystoscopic investigations, and was told that the right kidney was enlarged and floating and functioning poorly. The two catheterizations seemed to result in definite relief, and the patient has since worn an abdominal supporter and slept with the foot of her bed elevated eight inches. She has always had some discomfort in the right side since this attack ten years ago, but has not been incapacitated except with an occasional severe attack. One of these occurred eight years ago, when two ureteral catheterizations seemed to result in considerable relief. An attack five years ago was accompanied by hematuria and at that time it was found she had hypertension. Since then she has

FIG. 17. FIG. 18.

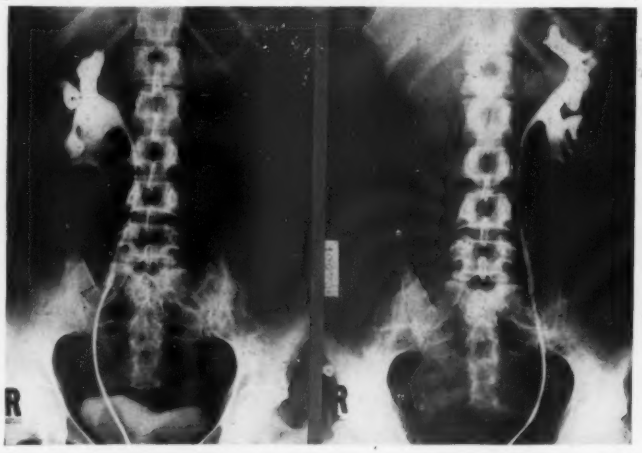

FIG. 17.—Case 10: Note dome-like rounding off of the lower calices by a large cyst in lower pole.
FIG. 18.—Case 10: Note splayed character of calices. Multiple filling defects in left ureter.

followed a low protein diet. The intermittent attacks of severe pain and hematuria without evidence of stone were most suggestive of the presence of ureteral stricture, and even more suggestive of this condition was the fact that the patient had experienced definite improvement in her condition immediately after the use of plain catheters in several investigations. She had been so much relieved by Doctor Traut's recent investigations, using the plain No. 7 catheter twice on either side, that she was in no hurry to have me undertake further treatment. For the three or four years preceding her first ureteral investigations, ten years previously, she had had considerable frequency of voiding, always arising four to five times at night. Since these first catheter investigations, the nightly voiding has been only once, and she has not been bothered with diurnal frequency except when she has an occasional "cold."

The patient had severe diphtheria at age 5, and was said to have had a tonsillectomy at that time. She had enlarged cervical nodes as a schoolgirl, but has had no history of tonsillitis. The tonsils are distinctly small and embedded, and, because of the occasional redness occurring about the faucial pillars, I have had them under suspicion as a possible cause of the resistance her ureteral strictures have shown to remain permanently dilated.

In addition to the above symptoms pointing more directly to the urinary tract, her chief complaints recently have been as follows: For perhaps the past six years, she gets up daily with a severe headache, usually occipital, at times frontal. Has worn glasses 20 years, last changed two years ago. Always backache with the menstrual period, and for the past five or six years has usually had a backache when she first arises in the morning. This is always worse in the right upper quadrant; at times some aching in the left upper quadrant. Both the headache and the backache usually disappear after she has been busy a few hours. At times some nausea and dizziness. Digestion good. Bowels regular. At times, when very active, she develops temporary swelling of the feet and ankles.

Physical Examination.—The left kidney was found to fill the left upper flank; its lower pole almost reached the transumbilical line, and on deep breathing descended below this level. The right kidney filled the right midflank. Its lower pole rested on a line below the level of the navel, and on deep breathing it descended to a level 5 cm. below that of the navel. One could apparently pass the abdominal hand above its upper pole. In its lower third a fairly large nodule projected on its anterior surface, probably causing the dome-like rounding-off of the lower calices, and the median displacement of the right ureter (Fig. 17). The patient has four or five dense stricture areas in each ureter (Figs. 17 and 18), and, during the past four years, there has been no rest interval between dilatations longer than six months. We have found that, for reasonable comfort, the dilatations must be kept above a No. 15 Fr. After a few weeks or months of comparative comfort, the patient again returned with an exaggeration of some of her symptoms, and we began dilatations with bulbs of No. 15 Fr. size, and on a second pair of treatments we used No. 16 Fr. and, if the wax bulbs do not mold down, we use a No. 17 Fr. on the third pair of treatments. If the No. 16 Fr. bulb molds to a slightly smaller diameter, the subsequent treatments are done with a No. 16 Fr. bulb until this passes without molding, when we step up to a No. 17 Fr. From October 12, 1934, to June 3, 1935, the patient had six pairs of treatments in order to reach a No. 17 Fr. dilatation. In January, 1935, when we had reached a No. 15 Fr. dilatation, we took a half-hour intravenous P.S.P., which showed:

	Ap. T.	Amt.	Per Cent
Right kidney (cath.)	2 min.	50 cc.	30
Left kidney (blad.)	12 min.	30 cc.	20

This shows a satisfactory improvement over Doctor Traut's test made five months previously, and registered above. Our two-hour P.S.P. made in January, 1935, showed: 30 min., 225 cc., 25 per cent; 60 min., 200 cc., 15 per cent; second hour, 250 cc., 10 per cent.

I think that of all our patients on whom we have had an opportunity to follow the treatments systematically, this patient has had the most regular follow-up and the highest dilatation, but has shown the least satisfactory results. In spite of this, the patient has been able to carry on with regular housekeeping, and as a half-time secretary and stenographer, and I think Dr. Traut, who has followed her progress closely, feels, as I do, that without the ureteral dilatations the patient would not be living to-day.

Case 11.—Mrs. E. H., age 54, was admitted to the hospital, May 6, 1935, in apparent extremis, with shortness of breath and general anasarca. One child 35 years of age. Patient first discovered a lump in her right flank soon after this child was born. A lump was discovered in the left flank 11 years ago, soon after an operation for intestinal obstruction. Has worked hard all her life up to two months ago, when the abdominal masses seemed to be getting larger; the edema, which had been intermittent, increased and became constant, and there has been increasing shortness of breath. There have been no bladder symptoms, and patient has not complained of headache or backache. Her mentality, considering her general condition, is remarkably alert. For several months, her appetite has been poor and there has been considerable nausea and vomiting. For two months, the bowels have been loose.

Physical Examination.—There seemed to be general edema, most marked over the hands and feet, and about the perineum. The flanks were distended by unusually large masses coming from beneath the costal margin and extending down to the pelvic brim. These were solid-feeling, nodular over the surface, and apparently movable, not tender. Evidence of ascites was not positive. B.P. 115/80, Hb. 68 per cent, W.B.C. 8,000; blood chemistry: N.P.N. 156 mg. per cent; Wassermann negative; two-hour P.S.P. 100 cc.; color insufficient to be read. May 10, 1935: N.P.N. 208 mg. per cent; urine, acid, sugar 0, albumin ++, occasional W.B.C. and R.B.C., casts 0, diacetic, negative. The patient died on her fourth day in the hospital.

Autopsy.—No. 14,209: Revealed immense polycystic kidneys, together weighing 14 pounds. There were diffuse sclerosis of the aorta and coronary arteries, cardiac hypertrophy and dilatation, chronic passive congestion of the lungs, cholelithiasis, edema and ascites. There had been no opportunity to examine the ureters clinically. The postmortem notes on the upper drainage tract were as follows: "The pelves are greatly distorted and open out abruptly into large cyst-like spaces. Near the junction of each pelvis with the ureter, however, the pelvis on each side shows a more or less normal morphology with a pale, smooth, white lining. The pelvis on one side, from the calices at one pole to those on the other, measures 13 cm. It is distorted by pressure of the cysts rather than distended. The ureters are small and thin and seem to be practically normal." Blocks were not taken from the ureters and these organs were not saved.

Case 12.—*Synopsis: Patent ductus arteriosus. Bilateral congenital cystic kidney. Bilateral ureteral stricture. For many years symptoms of headache, backache, gastrointestinal disturbances, mild bladder symptoms, but patient led an active, useful life until the past three years. Family history suggestive of renal disease. Three years of marked improvement after inadequate ureteral dilatation.*

In October, 1935, I received the following letter from Dr. Samuel Weisman, of Parsons, W. Va.: "Mrs. V. T., of this city, has consulted me complaining of general malaise and lassitude for the past three years. Her past history reveals that she was admitted to a local hospital about two years ago for a cardiac lesion which has since improved. Her general condition, however, has remained the same, and, on examination, I find that she has a large, irregularly shaped mass in each side of the abdomen. On careful palpation the surfaces of these masses appear to be studded with variously shaped nodules. The mass on the left seems to be the larger one. Both move with respiration. They are not tender. Unfortunately, there is no way of telling whether these masses were present on her previous hospital sojourn, as there was no record of any abdominal examination, and the patient does not recall any discussion of these masses."

The patient was admitted to the hospital, October 23, 1935, at which time we added the notes summarized in the synopsis recorded above. The suggestive family history was as follows: Patient's mother and an older brother and sister all have died of apoplexy during the past five years. A younger sister is now having occasional dilatation of ureteral stricture by Dr. H. D. Furniss, of New York City. (Seeing this last statement while compiling this paper, I wrote Dr. Furniss, asking whether this younger sister showed evidences of congenital cystic kidney. He replied that the patient had been referred to him soon after she had been operated upon for chronic appendicitis and gallstones. The patient's former surgeon reported that he had palpated the right kidney during the operation and found it to be one and one-half times the normal size, but that it seemed smooth in contour. Doctor Furniss kindly sent me prints of his urograms, and while these are not at all positive, they are suggestive of congenital cystic kidneys.

Physical Examination.—In addition to verifying Doctor Weisman's description of the conditions found in the abdomen, we could palpate the edge of a large, hard spleen. There had been no history of typhoid or malaria. B.P. 160/90, Hb. 60 per cent, W.B.C. 7,500; two-hour P.S.P.: 30 min., 550 cc., 28 per cent; first hour, 250 cc., 15 per cent;

second hour, 300 cc., 10 per cent, total 1,100 cc., 53 per cent. N.P.N. 32 mg. per cent, sugar 110; Wassermann negative. Catheterized bladder urine: Specific gravity 1,013, acid, trace albumin, culture negative. Dr. Benjamin Baker interpreted the heart condition as due to a patent ductus arteriosus and probable mild aortic coarctation.

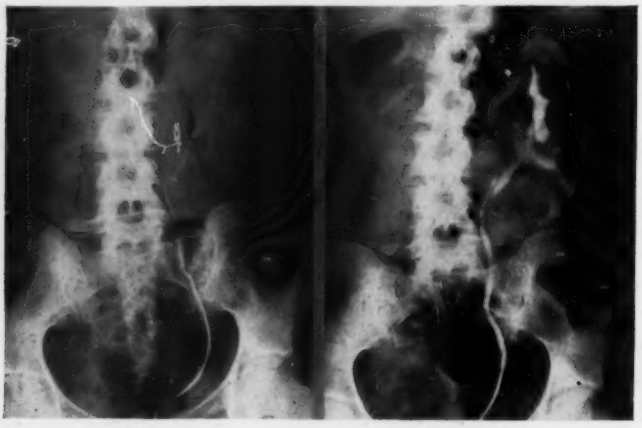

FIG. 19. FIG. 20.

FIG. 19.—Shows tip of radiopaque catheter at about brim of the pelvis, after its partial withdrawal from the previous high position. In other words, it had been stopped permanently at a point about opposite the fourth lumbar transverse process, where one sees a narrow area and a lateral deviation of the ureter. Patient complained of colicky pain referred to the bladder when only 4.5 cc. of NaI had been injected by 18-inch gravity pressure. The original film shows reflux of NaI below the catheter tip down to an area a few centimeters below the pelvic brim, and another slight dilatation of the lumen in the region of the broad ligament.

Note the failure of the NaI solution to reach beyond an apparent funnel-like pelvi-ureteral junction. This failure to fill the upper abdominal ureter may have been due to spasm, to narrow areas in the upper ureter, or to lateral pressure by the large mass. The No. 11 Fr. bulb had a definite "hang" at 12 cm. from the external urethra and again in the broad ligament region. Note rudimentary 12th ribs; dense shadow filling left flank; and shadow of descending colon displaced laterally.

FIG. 20.—Shows a urogram taken ten days after Figure 19. The No. 10 bougie with 5 cm. tapering tip enters the left side with considerable obstruction in the upper ureter; the patient complaining unusually much of pain in the upper flank and extending down to the groin and to the knee. A No. 8 whistle-tip catheter with a No. 10 Fr. bulb placed near the tip then meets an obstruction to the tip or the distal shoulder of the bulb when the tip has entered 27 cm. above the external urethra. Anuria for about one minute, then the catheter is drawn down about 13 cm. until the bulb "hangs" in an area about 11 cm. from the outside. Then practically normal spurts of a slightly bloody urine. The urogram shows slight dilatation of the ureter from the position of the bulb in the broad ligament to a relative narrowing opposite the fourth lumbar vertebra. Just above this apparent filling defect, there is a double shadow suggesting extravasation, but this irregular shadow is probably due to tetany of the ileopsoas muscle, for we see above a fairly good filling of the upper ureter and the pelvis and calices, suggesting the picture of a congenital cystic kidney. The unusual amount of pain experienced when the No. 10 bougie suddenly passed an obstruction in the upper ureter, suggested a splitting of the walls of a high stricture area; and the patient had an unusual amount of pain and soreness in the left flank for five days after this examination, although the temperature rose only slightly above 99° F. These facts later led me to believe that the urogram shows an extravasation, rather than a blurring of the ureteral shadow by spastic contractions of the ileopsoas. (In general, when gradually dilating high stricture, I believe it safer to depend on the use of dilating bougies, but experience has taught that one can split a stricture area with the dilating bougie, and extreme care must be exercised even when using the bougie with its filiform tip reaching full size 5 cm. back of the tip.) Ten days later, a No. 11 bougie was passed 35 cm. without undue resistance and without subsequent reaction.

Cystoscopic Examination revealed a much narrowed, infiltrated urethra, the bladder mucosa normal, the trigonum congested, right ureteral orifice very small, secreting freely; left orifice in a red area, not seen, found with curved metal searcher, very small. A No. 9 bougie with 5 cm. graduated tip enters left side 35 cm., considerable obstruction throughout its passage, and definite drag on withdrawal. Bleeding from orifice, and free spurts of urine. No spurts seen before dilating. Then a No. 7 whistle-tip radiopaque catheter carrying wax bulb of size No. 11 Fr. placed near the tip. The catheter obstructs permanently in about the midportion of the abdominal ureter. Anuria about one minute, then the catheter withdrawn about 10 cm., when a normal flow begins in peristaltic waves (Fig. 19).

In spite of our urging that she remain until we could establish a No. 14 or 15 Fr. dilatation, the patient became homesick and left after three weeks of hospital treatment. The hemoglobin had risen from 60 to 70 per cent, and the patient appeared greatly improved.

A recent letter from her, three years after what we considered inadequate ureteral treatment, shows that she has gone far beyond our expectations in her recovery from a condition of practically bed-ridden invalidism.

Case 13.—*Synopsis: Preoperative diagnosis: Tumor of left kidney. Ureteral stricture, multiple, left. Hydronephrosis slight, bilateral. Spina bifida occulta. Operation.—Exploratory celiotomy: Freeing of omental adhesions. Operative pathology: Congenital cystic kidney, bilateral; omental adhesions (former operations); multiple cysts of liver. Postoperative treatment: Intermittent ureteral dilatations up to a 5 Mm. (No. 15 Fr.) for two years following operation. Marked improvement in general health, but after a few weeks of overexertion, sudden death due to cerebral hemorrhage.*

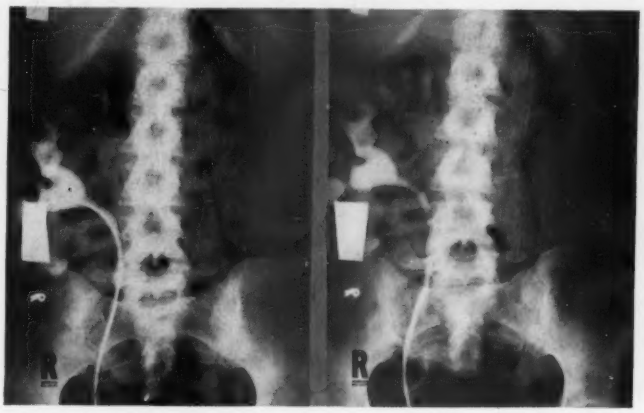

FIG. 21. FIG. 22.

FIG. 21.—Shows a urogram taken during patient's second treatment of the right side. The Nos. 10 and 12 bougies were first passed, meeting resistance in the lower ureter and dragging considerably on withdrawal. The No. 8 pointed-tip radiopaque catheter, with spiral wax tip and No. 13 Fr. bulb near the tip, then passed with definite obstruction to the bulb in the lower ureter. Free flow slightly blood-tinged urine. Right kidney takes slowly 10 cc. nupercaine without discomfort. This retained until patient reached roentgenologist. The low position of a large right kidney is clearly seen. The radiopaque catheter is well over in a lower median calix. Instillation of 18 cc. NaI. Right pelvis moderately dilated. Calices considerably dilated, and spread out in a manner characteristic of congenital cystic kidney. Normal funnel-like pelvi-ureteral opening. Reflux of NaI beside catheter to an area opposite the fourth lumbar vertebra. Moderate deviation of catheter toward spine.

FIG. 22.—Shows catheter withdrawn until the bulb "hangs" at 13 cm. from external urethra. Slight dilatation of upper ureter down to this area. Slight reflux of NaI around catheter in midpelvic portion of ureter. The 4.3 Mm. (No. 13 Fr.) bulb "hung" at 13 cm. and in one lower area.

Mrs. E. P., age 38, was admitted to the hospital, January 9, 1936. Married 17 years; para two, ages 12 and eight years. Stormy pregnancies, "due to nephritis and hypertension." Six years ago, a therapeutic abortion, followed one year later by abdominal operation for sterilization. Eleven years ago, first abdominal operation for Gilliam suspension and appendicectomy. Before operation at that time, the right kidney was palpable and the urine was negative. For many years had had hypertension, the systolic pressure being 230 at one time. There has been considerable headache and much mental depression. Edema of the ankles if active on her feet. Has always had rather severe dysmenorrhea and pain in the lumbar region during menses, these symptoms not improving after childbearing. Much gastro-intestinal disturbance, often accompanied by a "dollar spot" of rather severe pain located just to the left of the navel. For two years past, patient has noticed that, following the evening meal, the left side of the abdomen was markedly fuller than the right. Two months before admission, the

patient had a severe left renal colic. The pain in the left costovertebral angle remained steady and constant for two days, and on the third day there was marked hematuria.

Physical Examination was unimportant except as relating to the urinary tract. The left kidney seemed to be prolapsed and considerably enlarged. The lower pole reached a line about 5 cm. below the transumbilical line. The upper pole apparently could be outlined by deep bimanual palpation high up beneath the costal margin. The main portion of the renal mass seemed to lie beneath the rectus muscle and the median border lay along the midline. There was some tenderness on palpation of the upper third of the mass. The right kidney apparently could be completely outlined. It seemed

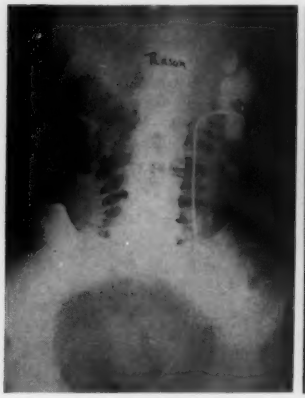

FIG. 23.

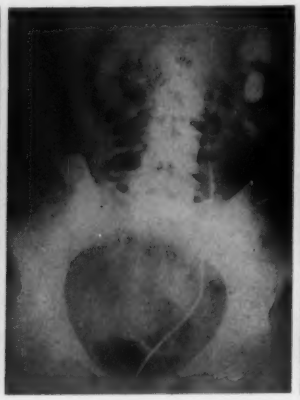

FIG. 24.

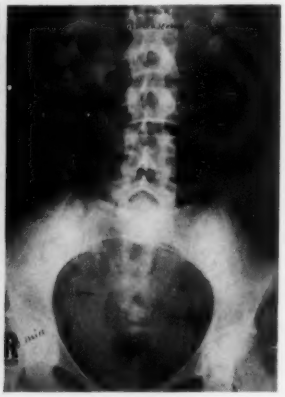

FIG. 25.

FIG. 23.—Shows the catheter tip apparently in a lower calix. Upper middle and lower calices somewhat dilated and clubbed. Renal cortex shadow apparently continuous downward into the shadow of a large mass filling the left flank and reaching to the crest of the ilium. About 4 cm. below the lower calix is an oval shadow, about 3x13 Mm. resting on the midportion of the mass shadow in the flank. No evidence of NaI connecting the lower calix with the shadow lying over the mass. No definite shadow of the renal pelvis, but the calix shadows suggest a trifid type of kidney, in which case one would expect the pelvis to be small. No reflux beside the catheter down the ureter. The right lower flank appears filled by a dense shadow, and riding over this is the gas shadow of the hepatic flexure and of the descending limb of a prolapsed transverse colon. The ascending limb of the transverse colon on the left is apparently crowded toward the spine by the mass in the left flank.

FIG. 24.—Is taken with the catheter withdrawn until the bulb "hangs" in an area at about the region of the hypogastric node, and the tip is resting at about the pelvic brim. There is slight reflux of the NaI to the level of the bulb and the abdominal spindle is of about normal diameter. Beside the fourth lumbar vertebra and the lower edge of the third, the ureteral lumen is very narrow. The upper end of the ureter widens slightly to merge with the pelvi-ureteral junction, which is indistinctly outlined. On withdrawal of the catheter we noted that "it came down about five centimeters and then the bulb (scant No. 11 Fr. 'hung' fairly firmly over a long diffuse area in about the midabdominal ureter."

FIG. 25.—Intravenous urogram: The ten-minute exposure shows active functions in both kidneys, the normal-sized bladder being well outlined. In the left flank, there is seen the group of three clubbed calix cups, apparently representing the upper and middle calices, and at some distance below these an indistinct shadow representing a pair of dilated lower calix cups. Still lower and to the left of the third lumbar vertebra is a small shadow, probably representing the lowermost separate calix seen in Fig. 24, and in one of the intravenous films this was seen to be connected with the pelvis by a thin spider-leg primary calix. The right pelvis with its moderately dilated calices is better outlined. The No. 9 bulb had no "hang" on the first investigation of the right side, but with the definite demonstration of multiple stricture in the left ureter, we felt that the presence of moderate hydronephrosis on the right side would, with the use of a larger bulb, be found to be due to stricture. Note spina bifida occulta of the fifth lumbar vertebra.

of normal or slightly enlarged size, in second degree descensus, rather firm, and somewhat tender over its upper third. The ureters were tender on palpation at the pelvic brim and in the broad ligament regions. B.P. 154/92, Hb. 64 per cent, W.B.C. 6,240; blood sugar 69 mg. per 100 cc., N.P.N. 45.4 mg. per 100 cc. Urine, acid, specific gravity 1,018, faint trace albumin; two W.B.C., no R.B.C., no casts. Two-hour P.S.P.: First hour, 250 cc., 40 per cent; second hour, 500 cc., 15 per cent.

Cystoscopic Examination.—Urethra generally infiltrated, dilates with some difficulty to No. 9 Fr., No. 8 Kelly cystoscope, bladder normal, trigonum and ureteral orifice

regions moderately red and vascular. The left ureter was catheterized with a No. 7 whistle-tip radiopaque catheter prepared with a scant 3.6 Mm. (No. 11 Fr.) bulb near the tip. There was obstruction to the tip, or bulb, in the broad ligament region and again near the kidney. A free flow of clear looking urine which showed microscopically a few epithelial cells, and proved negative on a slant agar culture. A half-hour intravenous P.S.P. showed:

	Ap. T.	Amt.	Per Cent
Left kidney (cath.).....	5 min.	55 cc.	8
Right kidney (blad.).....	5 min.	105 cc.	22

Operation.—January 16, 1936: *Tentative Diagnosis:* Tumor of the left kidney. Because of the uncertainty of the diagnosis, an exploratory incision was made through the left rectus muscle. This revealed a large polycystic left kidney. On exploring the right kidney it was found to be slightly larger than normal, and nodular with multiple cysts. Several nodules were felt on the inferior surface of the liver near the cystic duct and one nodule on the lower edge of the liver appeared like a retention cyst. The cecum was considerably dilated. The transverse colon was prolapsed and on exploring the pelvis a dense band of adhesions was found attached to the previously suspended uterus. This band spread out fan-wise to form a very small omentum. It was ligated and severed from the uterus, thus freeing the omentum and transverse colon. On more careful exploration of the left kidney, the upper pole, while still retaining a fairly normal outline, was found to contain many fairly large cysts. It was, therefore, decided not to resect the larger lower pole, and the abdomen was closed, in the hope that the patient might be benefited by later ureteral dilatations. The patient developed a postoperative pyelitis on the left side, but the fever subsided completely on the sixth day. Before operation, the urine from the bladder and from each kidney had been negative to culture. Before the patient was discharged, each ureter was dilated on two occasions up to a No. 12 Fr. bulb. Multiple stricture existed on either side, the highest stricture on the left being 25 cm. and on the right 23 cm. from the external urethral orifice. On each dilatation, colon bacilli were grown from the left kidney and culture from the right kidney was negative.

The patient was discharged 43 days after operation. Ten weeks later she reported that she developed pain on the right side together with fever, and a few weeks later had a similar attack on the left side. There had been a gain of six pounds in weight. The old pain in the left kidney region was present at times, but there had been no severe attacks except the one accompanied by fever. She had been on her feet a great deal for the past month and frequently developed swelling of the ankles.

Dilatations were carried on for two years at intervals of one to six months, finally reaching a No. 15 Fr. on each side. On March 10, 1937, 15 months after operation, her report of progress contained the estimate: "I feel 1,000 per cent better than for several years before operation." Her gain in weight had been from 117 to 130 pounds. The menstrual periods, for many years accompanied with severe pelvic and lumbar pains, and not relieved after childbearing, now seldom gave trouble. Her last treatment was in June, 1937.

Early in January, 1938, two years after operation, the patient reported that she was having a good deal of headache, backache, gastro-intestinal distress and swelling of the ankles. She lived with her two daughters in a third-floor flat, and in making merry during the holidays there had been much extra stair-climbing and other household duties. I advised that she spend as much time as possible during the succeeding week resting in bed, and then if not greatly improved to return for further treatments. A week later a cerebral hemorrhage occurred, followed by death in a local hospital two days later. I had arranged for an autopsy to include the entire urinary tract, but the

assistant-resident pathologist reported that the ureters "appeared normal" so were not removed.

Case 14.—*Synopsis: History of attacks of pain in left flank for nine years. Bilateral congenital cystic kidney. Bilateral ureteral stricture. Calculus left ureter. Good health to date, 20 months after treatment.*

Mrs. M. M., age 34, was admitted to the hospital, January 10, 1937. One child, age 4, living and well. Menstrual history normal. P.I.: Patient has had three attacks of pain in the left side, the first, nine years ago, the second, three months ago, the third, three weeks ago. Each attack came on suddenly, with severe pain beginning in the left lower abdomen and extending upward and back to the posterior flank. The pain has not extended downward to the perineum or thigh, but with each attack there has been a constant desire to void. No hematuria seen. Each attack has persisted for several

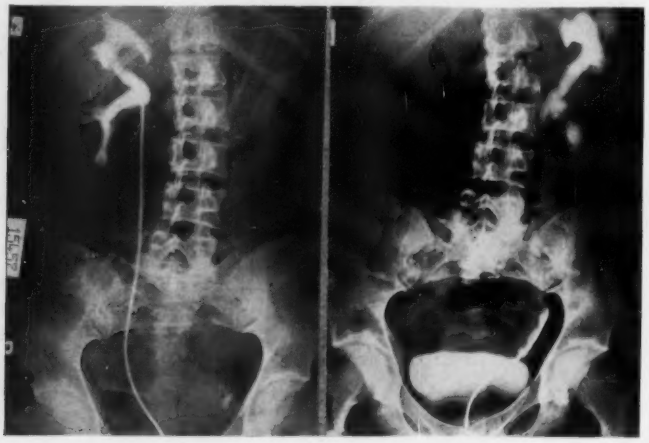

FIG. 26. FIG. 27.

FIG. 26.—Case 14: Right urogram showing bifid type of kidney with pelvis smaller than normal, but with dilated primary calices and rather characteristic splayed type of secondary calices. Note calculus in left ureter opposite spine of ischium.

FIG. 27.—Case 14: Bifid type of left pelvis which is smaller than normal. Dilated, splayed secondary calices. Instillation of 15 cc. of NaI reminded patient of her former attacks of pain. This roentgenogram was taken with head of the table lowered 45°, because the film immediately preceding this showed no filling of the abdominal portion of the ureter—still absence of filling, possibly due to lateral pressure of the large renal mass. Shadow of stone not seen, probably covered by the bladder shadow.

hours until relieved by hypodermics or oral medication. Has had nausea and vomiting with each attack. Has always enjoyed a good appetite, but for the past two years there has been considerable eructation of gas and a sense of fulness across the upper abdomen.

Physical Examination.—The abdomen is flat and appears normal, but palpation reveals a large movable mass in either flank. The mass in the left flank descends to a point about 5 cm. below the transumbilical line, and the inner border of its lower pole reaches almost to the midline. The upper pole cannot be identified beneath the costal border. The surface seems smooth, and there is slight tenderness on bimanual pressure. The mass in the right flank is slightly smaller, its lower pole descending to a line 2 cm. below the transumbilical line, and its median border reaches almost to the midline at a point 2 cm. above the navel. The upper pole cannot be outlined. The ureteral regions are tender at the pelvic brim. No desire to void on pressure. The outlet and pelvic organs seem normal. The left ureter can be palpated in the broad ligament region, and on high palpation one apparently outlines a stone about the size of a navy bean. The right ureter is not palpable. Pressure over each ureter causes an urgent desire to void. Urine negative. Hb. 96 per cent; W.B.C. 8,200; Wassermann negative; N.P.N.

29; two-hour P.S.P.: First half-hour, 175 cc., 10 per cent; second half-hour, 150 cc., 15 per cent; second hour, 500 cc., 20 per cent; total 45 per cent.

Cystoscopic Examination.—The urethra was infiltrated and was dilated to a No. 9 Hegar with difficulty. The bladder, trigonum and ureteral orifice regions appeared normal. Free spurting of urine from both sides. On the first attempt to dilate the left ureter, we could not pass even a fine whalebone filiform farther than 3 to 4 cm. Seeing the patient at monthly intervals for three times, we finally dilated each side to a No. 14 Fr. On March 16, 1937, after passing dilating bougies to a No. 14 Fr. on the left side, we introduced the alligator forceps and grasped the stone, situated about 5 cm. above the bladder, and removed it. Just before this operation the two-hour P.S.P. showed: First half-hour, 200 cc., 35 per cent; second half-hour, 240 cc., 15 per cent; second hour, 205 cc., 10 per cent; total 60 per cent.

On writing this patient a year later to remind her of the importance of a follow-up study to make certain her ureters were draining freely, she replied that she was expecting her second child within ten days, and that she had had no headache and no backache since her treatments and her physician assured her there had not been a trace of albumin during the pregnancy. Writing her during the preparation of this paper, nearly two years after the treatment, elicits the reply: "I hope to get down in May or June. I had my baby last March, a boy, and he is the picture of health. I had a very easy delivery and have felt fine since I came home from the hospital. My urine was normal at that time, and I have not been examined since. I have had no further pain in either side, and no bladder symptoms of any kind."

SUMMARY OF RESULTS.—In the 14 cases reported, the diagnosis of congenital cystic kidney was first made at operation in Cases 5, 6 and 13, all of these having had the probable diagnosis of renal tumor.

The diagnosis was first made by autopsy on Cases 2 and 4. Autopsy was obtained on three others, Cases 1, 11 and 13, thus confirming the diagnosis already made.

In Case 8, the three weeks old boy, the diagnosis had been made by the obstetrician and the pediatrician on the presence of extremely large nodular masses in either flank.

The diagnosis was made solely on the presence of bilateral abdominal masses and the characteristic urograms in Cases 3, 7, 9, 10, 12 and 14.

Opportunity to investigate for the presence of ureteral stricture was obtained in 11 cases (in all except Cases 4, 8 and 11) and stricture was diagnosed in ten cases. In another patient (Case 3) with interstitial cystitis, we found dilatation of the ureters which we attributed to the infiltration of the bladder walls. It may be of significance that in this case the ureters were more widely dilated than in any other member of the group.

Of the ten cases receiving either adequate or inadequate dilatation of the ureters, the following is a brief summary:

Case 1 died 17 years after dilatation was begun, and after 16 years of fairly good health.

Case 3: Interstitial ureterovesical thickening. One month of dilatations. Marked improvement in health. Death three months later.

Cases 5 and 6: Each in remarkably good health six years, to date.

Case 7: Continued work as a miner for about one year, then moved to another state and observation ceased.

Case 9: Excellent health to date, four years.

Case 10: Fair health to date, four years.

Case 12: Such dense strictures that treatment for three weeks carried dilatations to only No. 13 Fr. on right side and No. 11 Fr. on left side. Practically bed-ridden for three years before treatment, and, in view of her congenital heart lesion, has been much too active in the three years since.

Case 13: Fairly good health for two years, then death from cerebral hemorrhage.

Case 14: Uneventful delivery of child one year after treatment and in excellent health to date, eight months after delivery.

In seeking to estimate the value of this method of treatment, fortunately we are not entirely dependent on the patient's subjective response, but have, in addition, the objective evidence furnished by our repeated clinical studies. If there is marked anemia, this usually improves rapidly with the patient's improvement in general health. If there is hypertension, we observe a variation in response, as we do in dealing with ureteral stricture in general. In some patients with hypertension, the restoration of better renal drainage through the method of dilating ureteral stricture results in a decided and permanent decrease of the tension as long as the better ureteral drainage is maintained. In others, there is little or no decrease in the hypertension. If the patient with cystic kidney has blood nitrogen retention, this usually improves promptly on the establishment of better renal drainage. If the renal function, as indicated by the two-hour intravenous P.S.P., is subnormal, it usually increases as the ureteral drainage improves. If a pyelitis exists, it may clear up completely with no other treatment than the establishment of better drainage. Naturally, in dealing with these extremely malformed pelves, we are surprised when the ureteral dilatation, in a case with infection, results in a urine negative to culture; but in those instances in which the infection fails to clear completely, there is often restoration to such good drainage that the patient has no symptoms directly attributable to the continued presence of bacteria.

CONCLUSIONS

(1) Medical and hygienic treatment is helpful in many cases in relieving symptoms more or less characteristic of Bright's disease.

(2) Surgery offers the only hope of relief when certain secondary emergency complications arise. Inasmuch as the cystic disease is practically always bilateral, necessary surgery should aim at the conservation of all renal tissue that promises to recover. If preliminary examination reveals signs of malignant tumor or tuberculosis of one kidney, one should hesitate about operation unless careful tests show that the remaining kidney has fair promise of sustaining life.

(3) Evidence has been presented suggesting that many of these patients have bilateral ureteral stricture, and that in such cases, through simple ureteral drainage, we may obtain more prompt and more prolonged relief than pre-

viously has been thought possible. This calls for the earliest possible diagnosis in all suspected cases; and if stricture be present, we should establish the level of dilatation at which the individual patient seems to do best, and follow the patient at intervals, for years if necessary, to keep the ureters at their optimum of drainage.

(4) While this disease is of congenital origin, we know that some of its victims, without treatment, live to a ripe old age in the enjoyment of apparently good physical and mental health, and sometimes a diagnosis is made only at the autopsy table. Such facts should deter us from overenthusiastic claims concerning the value of any line of treatment. However, one cannot study the case histories presented above without concluding that the ureteral drainage methods have been of decided benefit in those cases where given adequate trial.

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DISCUSSION.—DR. R. H. CRAWFORD (Rutherfordton, N. C.): I am happy to obtain from Doctor Hunner, help in this type of case. Eighteen years ago we began the study of a family—intelligent people who could give an excellent history concerning themselves. Apparently the condition followed through four generations. The first two, we had to take from the history given us. In the remaining two generations we saw the majority of the patients.

In the fourth generation there were ten children. One died of typhoid at 13 years of age, but I saw and examined the remaining nine. They all had tumors—I thought one had escaped, but he now has two tumor masses meeting in the midline. Each of them has lived to between 30 and 45 years of age. A very interesting part of the study, which is still in progress, and I hope to be able to give it in detail eventually, is the fifth generation. Some of the children have congenital cystic kidneys. In the third generation, hematuria seemed to be the principal symptom, although toward the end they had a typical Bright's disease. The striking thing is that these large tumors were present without much discomfort. One patient had carried-on for a number of years as a teacher in a boys' school. He died at about the age of 40. Another, a dentist, had two tumors, and kept up his work until his death at 45. I think he lived longer than any of the nine. I hope to complete the study this year if we can get the children worked-up.

EARLY RECOGNITION OF SHOCK AND ITS DIFFERENTIATION FROM HEMORRHAGE

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A REVIEW of hypotheses concerning shock, of the facts which invalidate many of them, of the associated physiologic disturbances, and of recent interpretations resulting from a revision of experimental methods, will not be attempted here. Those interested in the author's analysis of the origin, mechanism and pathology of shock are referred to recent publications.[1]

A combination of evidence, from the fields of capillary physiology and of experimental pathology, indicates that diverse injurious agents and conditions exert harmful effects upon the capillaries; that any type of injury to capillaries causes the endothelium to become abnormally permeable to blood plasma; that dilatation of capillaries and venules in extensive visceral areas lowers the *effective* blood volume, and leakage of plasma decreases the *actual* blood volume; that these effects produce a disparity between the volume of blood and the volume-capacity of the vascular system, which disparity manifests itself in the syndrome of shock; and that hemoconcentration occurs regularly when this type of circulatory disturbance is developing.

Hemoconcentration.—The fact that hemoconcentration occurs when shock from various causes is developing has been known for many years. The earliest observations on this feature were, apparently, made in clinical studies on patients suffering from extensive burns of the skin. Baraduc[2] (1863) noted in such cases that the blood was dark, thick and that it failed to clot. He believed this change was related to the mechanism by which death occurred, that the thick, viscid blood could not circulate through the minute vessels and that this resulted in death by circulatory failure. Tappeiner[3] (1881) reported erythrocytic counts, ranging from 7,810,000 to 8,960,000 in from six to 17 hours after burns, in four cases which resulted fatally. Wilms[4] (1901) confirmed the previous observations and recorded cell counts ranging from 6,500,000 to 8,200,000 in six persons severely burned. Locke[5] (1902) reported blood counts in ten such cases. The highest count in four nonfatal cases was 7,266,000, while in five of the six fatal cases the erythrocytes were above 9,000,000. He recorded that the blood was dark and thick. Becky and Schmitz,[6] Underhill, *et al.*,[7] Simonart,[8] Moon,[9] Wilson, *et al.*,[10] Harkins[11] and others have confirmed that marked hemoconcentration occurs immediately after severe superficial burns of the skin.

Underhill and his associates reported blood studies in 20 cases of severe superficial burns. Marked hemoconcentration was found in each instance, as indicated by hemoglobin percentages ranging from 114 to 226 per cent. The higher concentrations were found in the more severe cases. The condition

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was associated with a decreased return of blood from systemic areas and with decreased volume output of the heart. This resulted in systemic anoxia, lowered metabolic processes, low arterial pressure and final suspension of vital activities. He believed that hemoconcentration is a prime factor in the development of shock from burns. He stated that the degree of concentration is an index of the patient's condition, that neither man nor animals can long survive hemoconcentration of 140 per cent, and that the condition becomes precarious at 125 per cent.

Sherrington and Copeman[12] (1893) noted an increase in the specific gravity of the blood of animals after abdominal operations. They suggested a relationship between this feature and surgical shock. Cobbett[13] (1897) described a series of experiments in which the specific gravity of the blood was noted at intervals after manipulation of the intestines of dogs. The data included a continuous record of arterial pressures. For a time the specific gravity was unchanged, but as edema and serous effusions developed, the specific gravity rose steadily and the blood became thickened so that it flowed with difficulty. For some hours after the specific gravity began to rise, the arterial pressure showed little or no sign of falling. When, at last, the blood pressure began to decline, it fell rapidly and death occurred soon. Cobbett noted three stages of effects in such experiments:

(1) Fluid was lost from the injured tissue, but the blood was unaffected because of fluid absorbed from other tissues.

(2) As the compensatory absorption of fluid became insufficient, the density of the blood gradually increased and signs of failing circulation began to appear, but the blood pressure remained unchanged.

(3) A rapid decline in blood pressure ending in death.

He concluded that circulatory failure after severe abdominal operations, in peritonitis and after burns, is accompanied by similar alterations in the blood.

Vale[14] (1904) recorded the specific gravity of the blood and tissues in experimental shock in animals and in human cases of shock from various causes. In experimental shock the specific gravity was increased and that of the tissues decreased, which indicated an increased fluid content of the tissues and a consequent inspissation of the blood. Shock in human cases, resulting from trauma, burns, peritoneal inflammation and from other causes, was accompanied by an increased specific gravity of the blood. An exception to this was seen when the condition had been complicated by considerable hemorrhage. The specific gravity returned to normal when recovery from shock occurred. Vale suggested that the observed phenomena resulted from damage to capillary walls. He was the first author to suggest that variations in specific gravity of the blood present a practical means for distinguishing between shock and hemorrhage.

Crile[15] (1909) recorded that in experimental shock the red cells are increased in number, but after hemorrhage their number per unit volume is decreased. Henderson[16] (1910) found the blood abnormally concentrated in

shock, and attributed this to leakage of plasma into the tissues. Mann[17] (1914) and many others have confirmed these observations, but none of these authors suggested the practical use of this test clinically.

Cannon, Fraser and Hooper[18] made cell counts on the blood of seriously wounded soldiers. They found red cell counts ranging from 6,000,000 in mild shock to above 9,000,000 in severe shock. The hemoconcentration was progressive and tended to be proportional to the degree of shock. Conversely, a decreased number of erythrocytes was found after hemorrhage and also in the blood of those who had served as donors for transfusions. Bayliss and Cannon[19] found corresponding hemoconcentration in experimental shock in cats. Bazett[20] found red cell counts of great value as indicating whether shock or hemorrhage was present and in determining the condition of the patient and the operative risk. In Robertson's[21] experience patients suffering from shock are to be distinguished from cases of hemorrhage or from hemorrhage plus shock by the presence of a high hemoglobin reading in the former.

The above findings were confirmed by Keith,[22] who showed that a marked decrease in the total volume of blood is an outstanding feature of shock. This is due to a decrease in the plasma volume and is accompanied by hemoconcentration. He concluded that one prominent factor was that the normal processes of blood dilution fail to operate. In moderate shock the blood cannot absorb fluid from the tissues nor from the gastro-intestinal tract, but the vascular walls are able to retain fluid if supplied in suitable form. In severe shock the vascular walls are unable to retain colloids or even whole blood. Fluids leak out into the tissues almost as fast as injected. Treatment in this class of cases was entirely ineffective.

Bainbridge and Bullen[23] found the hemoglobin content reduced after hemorrhage and increased during shock. They advise this as a practical means for differentiation of those conditions. They observed that the system is able to compensate for loss of blood by hemorrhage but that in shock this mechanism failed to operate.

There is agreement among investigators that decreased total volume and volume-flow of blood are essential features in the mechanism of shock. There has been disagreement concerning the origin of these features. A threatened disparity, between the blood volume and the volume-capacity of the vascular system, is compensated for a time by physiologic means. Activity of the sympatho-adrenal system results in maximal systemic vasoconstriction, thereby reducing the volume-capacity. Organs such as the spleen discharge their reserve of blood into the circulation. Fluid is absorbed from tissues into the blood, thereby increasing its volume. Let it be emphasized here that this mechanism of absorption depends directly upon the normal state of the capillary endothelium. Capillary walls so atonic and permeable that they allow plasma and cells to transude into the tissue spaces, are incapacitated for the function of absorption. The development of capillary atony deranges the mechanism of "water balance" and throws out of gear the machinery for compensating a

decreasing blood volume. So long as the mechanism of compensation is effective, there is no ominous decline in the arterial blood pressure.

Compensation and Arterial Pressure.—A decline in blood pressure has been regarded as the characteristic sign of shock, and few have realized that this is a sign, not of the developmental stage, but of circulatory decompensation. When the arterial pressure sinks below 80 Mm.Hg.—"the critical level"—the end is imminent.

Many authors have noted that a *rise* in blood pressure follows trauma of various kinds used in producing shock experimentally. We have noted this feature after injecting small amounts of tissue extracts intravenously. The injection of large doses caused the pressure to decline. Similar observations were made after implanting muscle pulp intraperitoneally (Chart 2). The increased arterial pressure under such conditions indicates effective compensation which may be followed by a decline, indicating decompensation. This view is supported by clinical experience. Gray and Parsons[24] stated that "a low blood pressure is not an essential accompaniment of the clinical picture, for the classical symptoms of shock occur while the blood pressure is at its highest recorded point."

Cope[25] stated that a fall in blood pressure is not the earliest nor the truest indication of shock, that no appreciable decline in pressure may occur until more than one-fourth of the total blood volume is lost, and that the pressure may be well maintained with a much smaller blood volume. He cited instances in which a late stage of shock was present while the blood pressure was well maintained. He stated that many cases of serious shock will pass unrecognized if low blood pressure is used as the chief or the sole criterion.

Freeman, Shaw and Snyder[26] devised a method for determining the volume-flow of blood in human beings. Their results indicated that a progressive reduction of the volume-flow was present during the development of surgical shock. In some instances the volume-flow was reduced almost to zero before the blood pressure gave any indication that shock was present. They concluded that variations of volume-flow of blood are more accurate indications of the presence and of the degree of shock than are variations in arterial pressure. However, no simple practical method has been devised for determining the volume-flow of blood clinically.

A Clinical Test for Shock.—Kennedy and I[27] confirmed the finding that hemoconcentration develops before pressure changes occur both in experimental shock and in human cases. Later we reported on the practical application of this test to clinical use. Our results showed that hemoconcentration occurs early, that it is proportional to the degree of the condition and that it is a clinical test of high practical value in detecting this type of circulatory deficiency, in estimating its severity and in differentiating it from hemorrhage.

My associates and I have produced shock experimentally by various means in more than 300 animals. These included 147 dogs, 98 guinea-pigs and smaller numbers of cats, rats, rabbits and monkeys. Hemoconcentration occurred regularly without exception in each animal and species. This devel-

oped early, before other signs of shock appeared, and the concentration of the blood progressed in degree proportional to the apparent illness of the animal. When recovery followed, the blood returned to its normal corpuscular composition. When death resulted, the postmortem findings indicated capillary atony in extensive visceral areas. This evidence included marked dilatation and engorgement of capillaries and venules with evident stasis of blood in them, ecchymoses, edema of soft tissues, and effusions in the serous cavities. The edema fluid and effusions were shown to have a high specific gravity and protein content, approximating that of the blood plasma.

Hemoconcentration may be shown either by hematocrit readings, by an increase in the specific gravity, by hemoglobin determination or by erythrocytic counts. Our experience indicates that the latter is more satisfactory as an index than either of the others. The erythrocytes sometimes increase in size by swelling. In such a case the hematocrit reading is not an accurate index of hemoconcentration. The curves of successive hemoglobin readings are more irregular and present more inexplicable variations than those of the red cell counts.

Accurate specific gravity determinations are difficult to make as clinical tests, though the method of Hammerschlag is simple and sufficiently accurate if carefully done. This consists in mixing chloroform with either xylol or benzine in such proportion that the specific gravity of the mixture ranges between 1.060 and 1.070 as shown by an ordinary urinometer. A drop of fresh blood is then placed in the mixture, using care to avoid including a bubble of air. If the drop sinks, a small amount of chloroform is added to increase the specific gravity of the mixture. If the drop of blood floats, xylol is added. When the mixture is adjusted so that the drop of blood remains suspended, neither rising nor sinking, it has the same approximate specific gravity as the fluid. This is then determined by a specific gravity spindle.

Variations in the specific gravity of the blood occur in a much narrower range than variations in counts of red cells. For example, before operation or injury the specific gravity may be 1.060 and the red count 4,900,000. When shock has developed, examination of the blood may show 1.075 specific gravity and 8,000,000 red cells. In this instance, the variation in the specific gravity was only 0.015 while that of the red cell count was 3,100,000. The index providing the widest range minimizes the variations due to technic.

We have found that hemoconcentration develops gradually after severe trauma, operations, intestinal obstructions and burns, but that it results immediately after the injection of bile, peptone, histamine, emetine and other substances which cause damage to endothelium. A rise from 5,000,000 to 6,000,000 red cells represents a concentration of 20 per cent. Such a finding indicates that the total blood-volume has been reduced about 10 per cent, and the plasma-volume about 20 per cent. A hemoconcentration of 20 per cent is ominous, for it indicates that the mechanism of shock is in operation even though no decline in arterial pressure or other evidence of circulatory deficiency is shown. Hemoconcentration of 40 per cent is a grave sign and is soon

followed by other evidences of circulatory disturbance. When the systolic pressure sinks below 70 or 80 Mm.Hg. the hemoconcentration may be anywhere between 40 and 60 per cent. Concentration of 80 per cent has been recorded frequently in the terminal stages of shock.

Differentiation Between Shock and Hemorrhage.—Hemorrhage and shock are often confused because of the similarity in their clinical signs. They may be differentiated readily by observations on the concentration of the blood. Loss of blood by hemorrhage results in dilution of the blood because fluid is absorbed rapidly from the tissues to restore the blood to its normal volume. The hemodilution is proportional to the amount of blood lost. This fact has been known for many years, and is illustrated by the following experiment.

The specific gravity, hemoglobin content and red cell count of a dog weighing 10.5 Kg. were carefully determined. Measured quantities of blood were then withdrawn at intervals, from a vein in the leg. The results are shown in Table I.

TABLE I

ALTERATIONS IN SPECIFIC GRAVITY, HEMOGLOBIN, AND RED BLOOD CELLS AFTER WITHDRAWAL OF 100 CC. OF BLOOD

	Time	Sp. Gr.	Hb.	Red Cells	Bled
3–15:	11:00 A.M.	1.056	98	5,400,000	100 cc.
	3:00 P.M.	1.055	97	5,320,000	100 cc.
	5:00 P.M.	1.055	95	5,300,000	
3–16:	10:00 A.M.	1.055	80	5,400,000	100 cc.
	11:30 A.M.	1.050	75	4,910,000	100 cc.
	1:00 P.M.	1.047	57	4,400,000	100 cc.
	2:30 P.M.	1.042	60	3,890,000	100 cc.
	4:15 P.M.	1.037	49	2,420,000	100 cc.
3–17:	9:00 A.M.	1.032	36	1,380,000	
	9:30 A.M.				400 cc. (death)

In each instance the blood examinations were made *before* the withdrawal of the volume of blood shown. It will be seen that a loss of 700 cc. of blood within 36 hours was sustained by a dog below average size. This reduced the hemoglobin to 36 per cent and the specific gravity to 1.032. At this time the dog showed no evidence of illness. It was active, normally playful, and probably would have recovered. A further loss of 400 cc. of blood, however, caused death.

Chart 1 shows diagrammatically the composition of normal blood in the first column. The second column shows the composition when hemoconcentration of 40 per cent is present. About 7 cc. of this concentrated blood (third column) contains the same volume of corpuscles as is present in 10 cc. of normal blood. This results from the loss of 3.0 cc. of plasma from each 10 cc. of blood. In other words, the plasma-volume has been reduced by 50 per cent, and total blood-volume by 30 per cent. The last column (right) shows the composition of blood after a hemorrhage which has reduced the hemoglobin and red cells to 40 per cent of the normal.

Simple examinations of the blood will usually differentiate between circulatory deficiency resulting from hemorrhage and that resulting from shock. In the former the blood is *below*, in the latter *above*, its normal or previous concentration. It may happen that the effects of hemorrhage are combined with the mechanism of shock. Such a combination is indicated by a *less marked* change in concentration. Therefore, when circulatory deficiency is developing, and yet the blood is only slightly above or below the concentration shown prior to operation, there is evidence that shock is combined with the effects of hemorrhage.

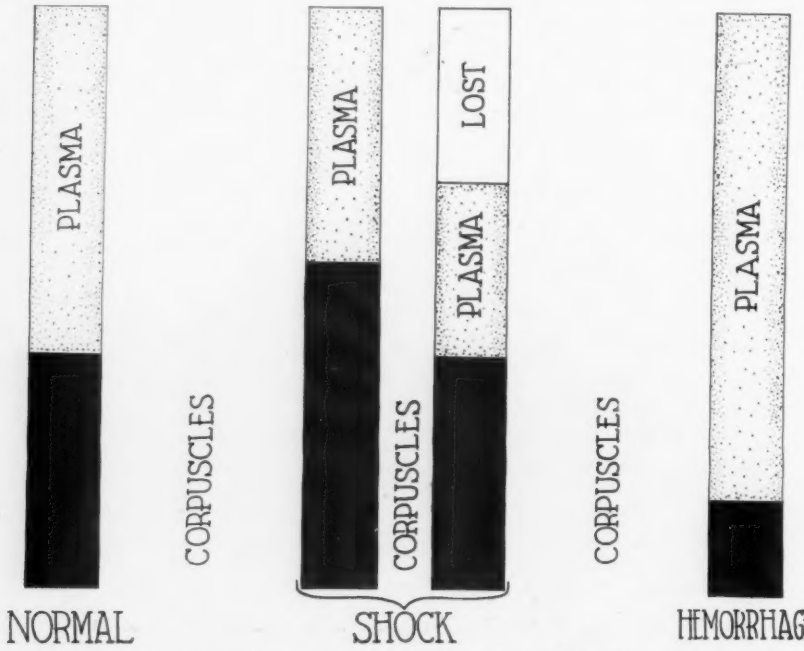

CHART 1.—Showing a volumetric comparison of normal blood with that present in shock and that resulting from hemorrhage. If normal blood (first column) becomes concentrated 40 per cent, it will have the composition shown in the second column. Seven cubic centimeters of such concentrated blood will contain the same volume of corpuscles (third column) as 10 cc. of normal blood, 3 cc. having been lost. In shock with hemoconcentration of 40 per cent, the normal blood has lost 30 per cent of its total volume and *50 per cent* of its *plasma-volume*. The fourth column illustrates the hemodilution which occurs when the corpuscles have been reduced by hemorrhages, to 40 per cent of the normal.

Experimental and Clinical Shock.—It has been shown[9] that the shock syndrome occurs clinically in many conditions other than after trauma or extensive operative procedures or after burns. My colleagues and I have produced shock experimentally by various methods which duplicated closely the conditions of its clinical occurrence. Surgeons are most concerned with shock resulting from extensive traumatic injury or from surgical intervention. The following method closely approximates the conditions resulting from extensive injury to muscles.

A quantity of muscle was excised aseptically from a freshly killed normal dog. This was finely ground up in a meat chopper under aseptic precautions

and was then suspended in saline solution. Varying quantities of this preparation were introduced into the peritoneal cavities of normal dogs under light ether anesthesia. Records were made of the pulse rate, respirations, temperature, hemoglobin content and red cell count three times each day before and after this procedure.

When doses of 5 Gm. or more per kilogram of body weight were used, illness developed within two or three hours. Thirst was evident, but vomit-

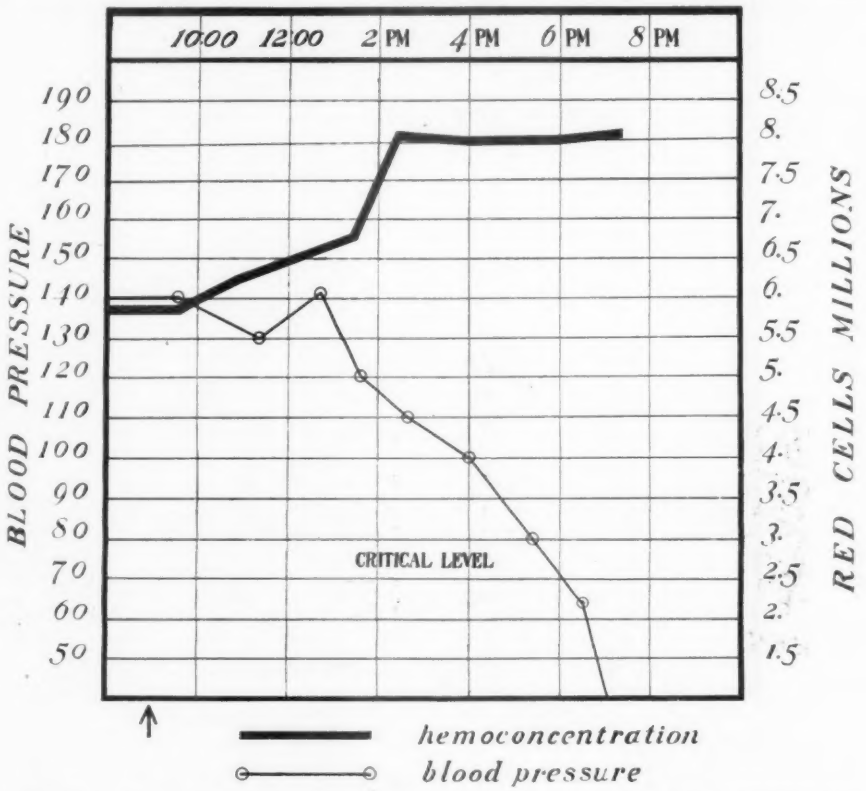

CHART 2.—Showing the curves of hemoconcentration and blood pressure as shock developed after placing muscle substance in a dog's peritoneal cavity (arrow). Blood pressure is shown at the left and red cell counts in millions at the right. Clock time is shown at the top. It is seen that hemoconcentration developed immediately, reaching 15 per cent four hours later, at which time the blood pressure was above 140 Mm.Hg. The blood reached its maximum concentration four hours before the blood pressure declined to the critical level, 70 to 80 Mm.Hg.

ing followed when fluids were taken. The vomitus contained bile, mucus and flecks of blood. The urine was scanty and often contained blood. Diarrhea frequently developed, and the feces showed mucus and bloody fluid. Hemoconcentration sometimes developed within an hour and it occurred regularly before the arterial blood pressure began to decline. The concentration was progressive and its degree was proportionate to the apparent illness of the animal. A condition of collapse, relaxation and stupor preceded death.

Smaller doses of muscle substance produced the same signs of illness, but less rapid in development and in degree. Death did not occur so early. Re-

covery often occurred after doses of 3 Gm. or less per kilogram of body weight.

Shock was produced by this method in each of 56 dogs. Many of the results of those studies have been reported elsewhere. In one group of experiments the dogs were maintained under light ether anesthesia through a tracheal tube, and a continuous kymographic record of arterial blood pressure was made for comparison with the curve of the hemoconcentration. In such instances shock developed more rapidly because of the contributory effect of anesthesia. The following experiment is typical of this group:

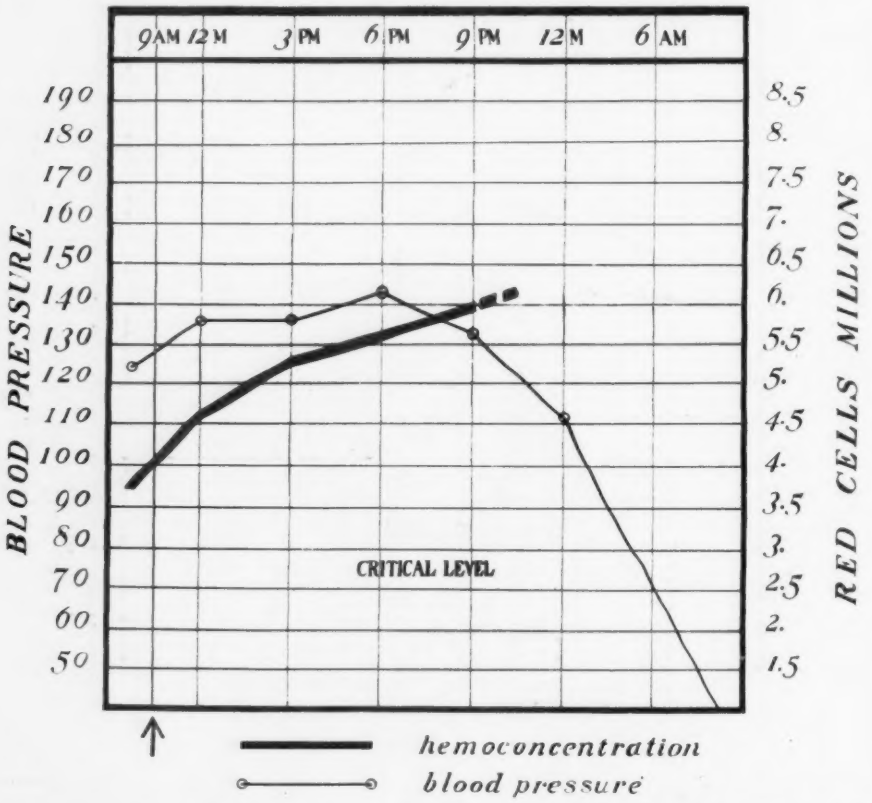

CHART 3.—Showing the curves of hemoconcentration and blood pressure during the development of shock after colonic resection (arrow).

In this instance the concentration of the blood indicated impending circulatory deficiency at 12 M., which was 12 hours before arterial pressure gave a similar indication. The mechanism of compensation was, apparently, adequate until about 9 P.M. by which time hemoconcentration of 60 per cent had developed. Yet at this time the blood pressure was still at a normal level.

Four grams of minced muscle substance, per kilogram of body weight, was introduced directly into the abdominal cavity of a normal dog through a short incision. Progressive concentration of the blood began almost immediately and had reached a degree of 15 per cent three hours later, at which time the blood pressure was at its highest point. The hemoconcentration had reached it maximum almost four hours before the blood pressure had declined to a critical level (70 to 80 Mm.Hg.). The course of the hemocon-

centration and blood pressure is shown graphically in Chart 2. Repetitions of this experiment gave uniformly similar results. In every instance the maximum concentration of the blood occurred several hours before the blood pressure sank to the critical level.

I have had opportunity to compare hemoconcentration with blood pressure readings in a number of clinical cases during the development of circulatory deficiency of the shock type. In each instance examination of the blood

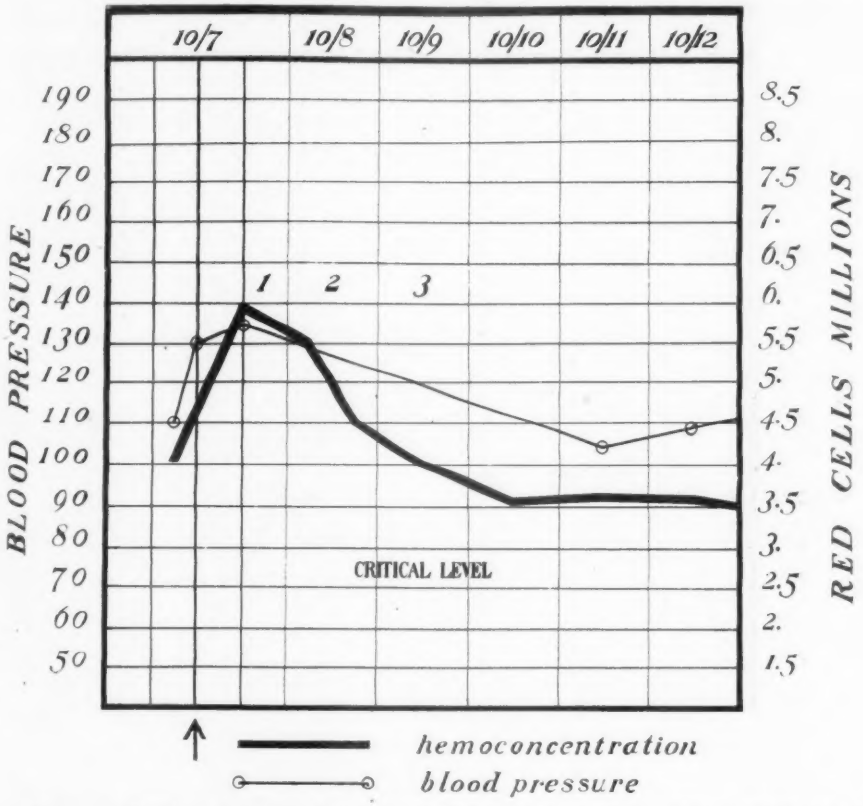

CHART 4.—Showing the curves of hemoconcentration and blood pressure after operation (rectal resection for carcinoma, arrow) followed by recovery.
Note the immediate rise in concentration indicating the imminence of circulatory failure and the accompanying rise in arterial pressure indicating active compensation. Transfusions of blood and glucose in saline intravenously were administered after the operation and on the next day (1 and 2). Saline hypodermoclysis was administered on the following day (3).

forecast the development of the shock several hours to several days before the blood pressure declined notably. A few instances will be cited:

A white female, age 54, had been prepared for colonic resection by a previous colostomy operation. The resection under ether anesthesia was finished in 35 minutes. The patient's condition as indicated by pulse, respiration and blood pressure was satisfactory on return to her room. The blood pressure was not only well maintained, it actually *increased* for several hours so that at 6:00 P.M. it was at its highest point. Meanwhile hemoconcentra-

tion had developed steadily (Chart 3). The erythrocytic count rose from 3,820,000 before the operation to 5,500,000 nine hours later—a concentration of more than 40 per cent. The concentration of the blood three hours after the operation forecast the impending circulatory collapse 12 hours before compensation failed. Death occurred by shock 26 hours after the operation.

In another case, a rectal resection for carcinoma, hemoconcentration of 36 per cent occurred within a few hours, while the blood pressure was at its

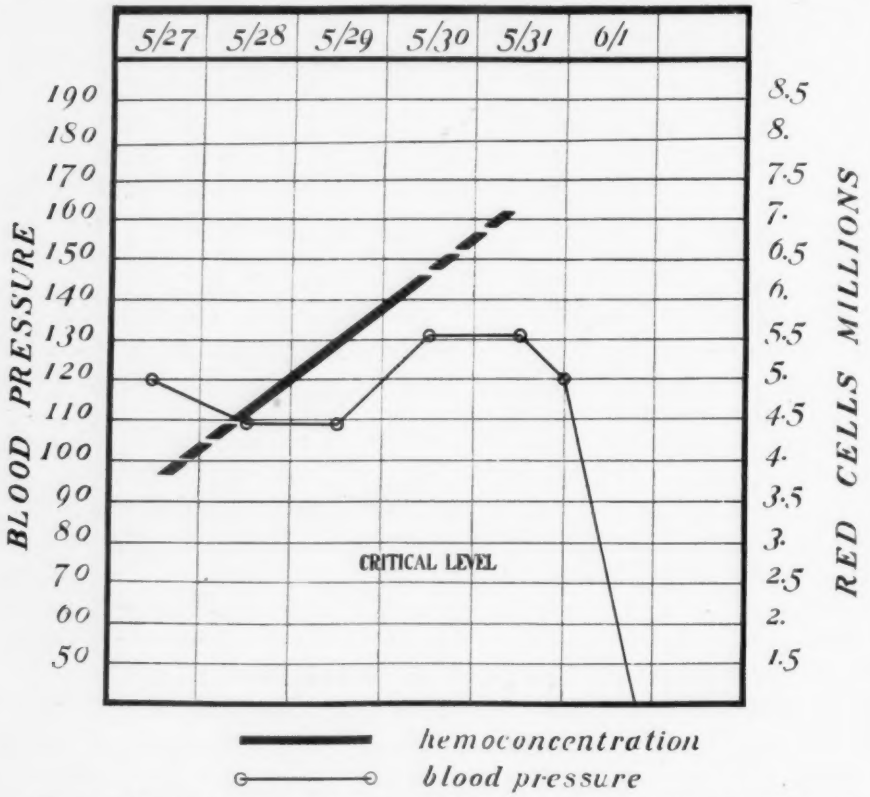

CHART 5.—Showing the curves of hemoconcentration and blood pressure incident to icterus gravis. Time is shown in calendar days. Only two counts of erythrocytes were made. The heavy solid line connects them.

In this instance hemoconcentration of 40 per cent was accompanied by a compensatory rise in arterial pressure, and occurred two days before death. Note the precipitate fall in blood pressure when compensation failed.

highest recorded point (Chart 4). Transfusions of blood and repeated intravenous infusions of glucose in saline after the operation, and on subsequent days, were followed by recovery.

Circulatory failure incident to systemic intoxication was illustrated in an instance of icterus gravis, with fatal termination on the sixth day of hospitalization. The blood count on May 28, the day after admission, was 4,490,000. Two days later it had risen to 6,240,000—an increase of 40 per cent. During this time the blood pressure *rose* from 110 to 130 Mm.Hg. Two days later the blood pressure had declined only to 120 but the decline continued precipi-

tately, ending in death (Chart 5). Hemoconcentration in this instance preceded the circulatory collapse by two days, during which time the blood pressure gave no intimation of impending failure of compensation.

SUMMARY.—I have reviewed all records of hemoconcentration or acute erythrocytosis which could be found in medical literature, only a few of which have been cited in this paper. The evidence summarized from these reports indicates that hemoconcentration is related etiologically to the mechanism by which the syndrome of shock develops in various clinical conditions. Most of the authors attributed the hemoconcentration to the leakage of plasma through endothelium which had been rendered abnormally permeable by some injurious agent or condition.

Our experimental studies have included intraperitoneal introduction of muscle, liver and other tissue substances, injections of watery extracts of normal tissues, of bile and its salts, peptone, bacterial cultures and toxins, histamine, snake venoms, and drugs such as emetine, veronal and other barbiturates. They also included burns, trauma, intestinal manipulation and obstructions, and the effects of proteins in sensitized animals.

Regularly, and without exception, the agents and conditions mentioned produced hemoconcentration. This appeared early, and its degree was proportional to the apparent illness of the animal. When recovery followed, the blood returned to its normal composition. When death resulted, the postmortem findings were those which we[28] have shown to be characteristic of shock.

It appears that any agent or condition which affects capillary endothelium adversely will produce the syndrome of shock if that effect is produced systemically or in extensive visceral areas. Both the experimental and clinical observations indicate that hemoconcentration is the surest and earliest clinical sign of endothelial damage of sufficient extent or degree to impair the efficiency of the circulation.

It is strange that a phenomenon which is so grave in its import, so common in its occurrence, and so easily demonstrated, has not been utilized by physicians in their clinical studies of patients.

CONCLUSIONS

Arterial blood pressure is not an accurate criterion of the presence of shock. The latter may be present while the blood pressure is well maintained or is even at its highest recorded point.

Hemoconcentration is progressive, it is an index of the degree of shock, and it subsides to normal as shock is abated. Also it furnishes a means for distinguishing between shock and hemorrhage. In the latter condition the blood is diluted to a degree proportional to the effects of the hemorrhage.

The presence of hemoconcentration is the earliest clinical sign of shock. It is easily detected, is regularly present before other signs appear and results from the same mechanism which causes shock. Its use as a clinical test facilitates the early recognition and treatment of shock.

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DERMOID CYSTS OF THE VERTEBRAL CANAL*

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SINCE Cruveilhier's[6] description of an intracranial "tumeur d'apparence perlée" (1829), dermoid cysts have been encountered frequently in the brain. A spinal dermoid, however, is still a rare operative or autopsy finding. Since 1875, the presence of dermoid or epidermoid cysts in the vertebral canal has been reported in 40 instances, the present contribution of three such cases being included. This paper presents a summary of the records and a brief consideration of the anatomical and clinical aspects of these tumors.

Bostroem's[2] term "dermoid" and "epidermoid" (1897), currently more acceptable than Müller's[29] "cholesteatome" (1838), denotes a group of congenital growths which "commonly originate by the inclusion of a portion of ectoderm during closure of embryonal fissures, or at the point of union of ectoderm with other structures along the course of ectodermic invagination or from persistent embryonal ectodermal structures" or from trauma or teratomatous remnants (Ewing,[11] 1931). The type and location of the cyst appear related to the age of the fetus at the time of the inclusion error. They may be single or multiple; they may contain any or all of the products of the skin and its glands, though epidermoids do not as a rule contain hair.

In this presentation we have not differentiated between dermoid and epidermoid. We have assumed the accuracy of the pathological diagnosis in all instances. The following cases have been previously reported.†

CASE REPORTS

Case 1.—Eppinger,[10] 1875: This case is referred to by Critchley and Ferguson.[5] We have been unable to corroborate the reference because the article is not available.

Case 2.—E. Chiari,[4] 1883: A male, age 33, had had symptoms of a "transverse myelitis" for 19 years. A subpial cholesteatoma 4 cm. long, extending from the fourth to the sixth thoracic nerve segments, was discovered postmortem. It was adherent to the pia mater at the point of greatest circumference and came into close relationship with the ependyma of the central canal.

Case 3.—Muscatello,[30] 1893: A female, age 5 months, was previously examined for a thoracic spina bifida. An incidental finding was an extradural cholesteatomatous cyst the size of a large pea, located over and attached to the periosteum of the fifth lumbar vertebra.

Case 4.—E. Trachtenberg,[43] 1898: This unusual case was a male, age 55, with a history of symptoms of spinal cord compression for four years. Autopsy revealed multiple intra-arachnoid and medullary dermoids and epidermoids. These were small, and extended for a considerable distance along the spinal canal and into the cranial cavity.

Case 5.—W. H. White and A. D. Fripp,[47] 1900: A male, age 30, had been suffering for four years from Hodgkin's disease. There was a history of rapid loss of strength for a period of three months, culminating in a complete paralysis and anesthesia below a point three-quarters of an inch below the nipples. There were shooting pains in the chest and upper extremity with superficial tenderness over the spinous processes of the second, third and fourth dorsal vertebrae. Surgical

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† Since this article was submitted for publication two more cases have been added to the literature.

intervention revealed a tumor at the level of spinal tenderness which, when sectioned, proved to be a large dermoid cyst. It was too large for removal at one stage. Two months after the first operation a second was performed which resulted fatally.

Case 6.—N. S. Ivanoff,[19] 1903: Quoted by Lauterberg[23] (1923) and Gross[15] (1934). Autopsy upon this anencephalic monster revealed a cavity, lined by several layers of flat epithelial cells, traversing the entire cord and medulla. The cytoplasm of the lining cells contained a horny substance, and hair follicles were seen. The abnormality was described as a cholesteatoma.

Case 7.—F. Raymond, L. Alquier and V. Courtellemont,[35] 1904: A male, age 32, had had symptoms indicating an intracranial abnormality for two years. At autopsy there was found a large frontal lobe dermoid with small meningeal dermoid nodules in the spinal subarachnoid space. These incidental spinal findings were unrelated to the symptoms of which he complained. In this case, small cholesteatomatous masses were reported in the spinal fluid on puncture.

Case 8.—F. Berkal,[1] 1906: A female, age 27, had had a "transverse myelitis" type of symptom complex for eight years before investigation. A subpial cholesteatoma, 10x3 cm. in size, was found (probably at autopsy) in the substance of the conus medullare attached to the central canal and the meninges. This unavailable report was summarized by Lauterberg, Salotti,[38] and Marinesco and Draganesco.[25]

Case 9.—Harriehausen,[17] 1909: A female, age 23, had had pain in the left leg for nine years, followed by bilateral leg weakness and hyperalgesia at the seventh thoracic segment. At postmortem examination an intramedullary dermoid, 5x2½ cm., cylindrical in outline and involving the central canal and the pia, was discovered at the level of the first lumbar vertebra. An interesting associated condition was redoubling of the spinal cord.

Case 10.—K. Frick,[14] 1911: A female, age 64, died after a nine year history of spastic paraplegia and anesthesia of the lower extremities. At autopsy a subdural dermoid was found pressing the cauda forward at the level of the second to fifth lumbar veterbrae.

Case 11.—T. von Verebely,[45] 1913: A male, age 15, had a double spinal cord cyst "the size of an apple" in the lumbar region. Of these cysts, one was a true dermoid while the other was a "forerunner of a neuro-epithelioma." These were encased in extradural fat and were connected by a canal which bore no lining epithelium. The findings were postmortem. Marinesco and Draganesco regard this case as an exceedingly important one because of the probability of fetal inclusions and teratoid formations. It is presented as a dermoid by its author, however, and we include it here.

Case 12.—W. E. Robertson and S. D. Ingham,[36] 1916: A female, age 19, had had a dragging sensation in the left leg and back beginning five years before operation. When first seen, she had paralysis and anesthesia of both legs. A "subdural cholesteatoma" 5½x1 inches in dimension was found among the nerve roots of the lumbar region.

Case 13.—C. Elsberg,[9] 1917: A female, age 60, had had occipital pain for three years. For six months there had been weakness and numbness in the right arm. Later, bladder trouble, generalized numbness and left-sided weakness appeared. A subdural dermoid extending from the fourth cervical vertebra into the occiput was found at operation. The intracranial portion was removed later. (The author draws attention to the lack of respiratory symptoms.) The patient died six months afterwards.

Case 14.—Guizetti,[16] 1921: This case, reported by Salotti (1927), was that of a female, age 39. No symptoms were mentioned but there was found a large dermoid, 7x2 cm., attached to the pial meninges in the lumbosacral region.

Case 15.—W. Lauterberg,[23] 1922: A male, age 7, was found to have an epidermoid cyst 12x10x8 Mm. in the region of the cauda equina, in the subdural space. It contained cholesterol crystals at its center and had a lamellated structure at its periphery. An epidermal membrane could be demonstrated over but a small part of the structure. The tumor was an incidental finding at autopsy after death due to an encephalitis.

Case 16.—G. Marinesco and Draganesco,[25] 1924: A male, age 30, had been ill for six months with weakness of the lower extremities. He was operated upon and a subdural cholesteatoma was found at the level of the ninth dorsal vertebra. Pieces of it were removed. The patient died seven years later. At necropsy a tumor was found at the level of the tenth and eleventh dorsal vertebrae where it had destroyed the cord. Below, the cord appeared normal; above, there were syringomyelic changes.

Case 17.—Dal Bo,[7] 1926: The case is that of a dermoid cyst in a female, age 42. This incredibly huge mass extended from the seventh thoracic vertebra to the cauda equina and was 17 cm. in length and 12 cm. in circumference. Salotti, who reports this case, points out that the tumor had dilated the intravertebral space.

Case 18.—N. Melnikoff-Raswedenkoff,[26] 1926 (reported in 1931): In a discussion of 17 cases of dermoid and epidermoid cysts of the central nervous system, mention is made of an intramedullary epidermoid. This was in a male, age 26, who had been afflicted with paraplegia. A cyst, 8x10 cm., was found between the fifth and sixth dorsal interspaces.

Case 19.—A. Salotti,[38] 1927: A male, age 31, had had regional anesthesia and decubitus ulcers for 17 years. A tumor was localized at the twelfth thoracic vertebra. At operation, a dermoid cyst 12x2½ cm. in size was removed. The patient died shortly afterwards due to septicemia from his decubitus ulcers.

Case 20.—T. A. Shallow,[40] 1928: This is a case of a small dermoid cyst in a male patient, age 30. Symptoms were of one year's duration and were those of spinal cord compression associated

with lumbar pain. At operation, a cyst was found surrounded by roots of the cauda equina. It was removed successfully. There was great relief from pain in the back and the patient was walking in a month. The impaired bladder function was improved after the first year.

Case 21.—M. Critchley and E. R. Ferguson,[5] 1928: A male, age 15, with a history of "meningitis" at age 3, and an unexplained paralysis of the legs at age 7, developed influenza. After three weeks in bed he developed severe leg pains and could not stand or walk unassisted. Although there was no sphincter loss, signs of pyramidal irritation were found in the lower extremities and there was a sensory level at the eighth thoracic segment. A noncapsulated tumor, later diagnosed "true epidermoid," lay beneath the laminae of the seventh and eighth thoracic vertebrae. It was subdural and bound up with the pia-arachnoid. Recovery was complete.

Case 22.—L. Delrez,[8] 1929: The patient was a female, age 5. For two months prior to investigation, she had had sensory and motor symptoms of spinal compression. She was operated upon and a dermoid cyst found extending from the level of the third lumbar vertebra to the sacrum. The patient recovered from the operation but unfortunately there was an associated sarcoma of the kidney.

Case 23.—John Fraser,[12] 1930: A male, age 22, had had midback discomfort for one year. This had become girdle-like in the region of the groin, with shooting pains and a numb feeling aggravated by activity. General clonic contractions of both legs on going to sleep, a disturbance of gait and loss of sphincter control appeared shortly before investigation. At operation an epidermoid cyst, 9.5x0.7 cm. in maximum diameter, was discovered in the posterior median fissure at the level of the eleventh thoracic nerve segment.

Case 24.—P. Pitotti,[33] 1930: At the autopsy on a male, age 26, who had died of pyelonephritis, a large sacral dermoid cyst was found, compressing the cauda equina. There is no history of related symptoms.

Case 25.—P. L. Hipsley,[18] 1932: A female, age 3, had had a discharging sinus in the upper back, and pain in the left chest for several weeks. Four weeks before examination, difficulty in walking appeared. Lumbar puncture yielded xanthochromic fluid which coagulated on standing and contained 72 cells per cu. Mm., 80 per cent lymphocytes and 20 per cent neutrophilic granulocytes. Lipiodol injected into the cisterna magna was arrested at the level of the seventh cervical vertebra. At operation a dermoid cyst, 18x12.5 Mm. in size, was removed. It was firmly adherent to the dura. The postoperative course was uneventful.

Case 26.—J. Michelsen,[27] 1932: Following spinal anesthesia, this female, age 32, developed a motor and sensory incapacity. After a three and one-half year remission the symptoms recurred. At operation a mass, later identified as a "cholesteatoma," was found arising from the pia in the midline, posteriorly, at the eleventh and twelfth thoracic vertebrae. Death followed removal.

Case 27.—A. H. Schroeder,[39] 1932: A female, age 35, had had weakness which commenced in the right leg one and one-half years earlier. The clinical findings were slight involuntary movements in the left leg and right hallux; diminished sensation below the second lumbar segment; and tender spinous processes on the eleventh and twelfth thoracic vertebrae. A "cholesteatoma" lay at the end of the cord beneath the laminae of the tenth and eleventh thoracic vertebrae. It was successfully removed.

Case 28.—W. J. Mixter,[28] 1932: A male, age 23, had a dull, low back pain commencing six years previously. Later, stabbing pain and weakness were experienced in the right knee. Before operation, disability included weakness, pain and numbness in both legs and hands. There was roentgenologic evidence of bony canal dilatation. A dermoid, "the size and shape of a sausage," was found splitting the dorsum of the cord. It was evacuated and partly excised. Symptoms recurred one and one-half years later.

Case 29.—P. Ottonello,[32] 1933: A female, age 20, had suffered for two weeks prior to admission, with motor and sensory symptoms, including marked hyperreflexia, bilateral Babinski reflexes and vesicorectal incontinence. At operation, an extramedullary dermoid, 6.5x2 cm. in size, was removed. The patient recovered. An interesting associated condition present in this case was rachischisis.

Case 30.—S. W. Gross,[15] 1934: For several years this male, age 44, had had pain, atrophy and weakness in all extremities. A sensory and vasomotor level, more right than left, was found at the fifth thoracic dermatome. An intramedullary dermoid projected 4 to 5 Mm. into the left side of the cord at the level of the disk between the second and third vertebrae. It was firmly attached at the bottom. It recurred three years later.

Case 31.—H. C. Naffziger and O. W. Jones, Jr.,[31] 1935: A female, age 60, since age 18, had complained of a weak back. At age 30, she had had "acute lumbago" followed by constant backache. At age 57, an operation for spina bifida occulta partially relieved the weakness, numbness and muscle spasm in the right leg. One year later, the pain in the left leg became so severe that, coupled with accentuation of the remaining right-sided symptoms, it prevented walking. A fusiform dermoid cyst of the cauda equina, 2x3.8 cm., was found to extend from the twelfth thoracic to the second sacral vertebrae. Though it could not be removed *in toto*, 45 Gm. of cheesy, hair-containing material was evacuated. Recovery was complete save for right-sided foot drop.

Case 32.—H. C. Naffziger and O. W. Jones, Jr., 1935: For two years this female, age 27, had had increasing pain radiating from the third lumbar vertebra, first to the left and then to the right leg. For 20 months she had had urinary frequency. For two months, she had been incontinent.

Roentgenograms showed a widened vertebral canal in the region of the twelfth thoracic and first lumbar vertebrae. At operation an intradural "cholesteatoma" of the filum terminale was found extending distally from the twelfth thoracic vertebra. It contained 9 Gm. of cheesy material. Calcium deposits and nerve fibers were present within its capsule. Recovery ensued except for persistent sensory changes.

Case 33.—H. C. Naffziger and O. W. Jones, Jr., 1935: A female, age 33, had increasing knee, hip and sacro-iliac pain accompanied by weakness and spasm of the leg muscles for nine months following chiropractic manipulations. There were no objective sensory signs. Leg and trunk movements were limited. A spinal subarachnoid block was demonstrated at the level of the third and fourth lumbar vertebrae. An intradural cholesteatoma, 1.5 cm. in diameter, was removed from among the roots of the cauda equina. Recovery was complete.

Case 34.—H. C. Naffziger and O. W. Jones, Jr., 1935: A male, age 45, had had "bladder symptoms" for 16 years. In the decade preceding investigation, there had developed perineal numbness, followed by paroxysmal pain, weakness and anesthesia in the legs. On admission, skin sensations were absent in the first four sacral dermatomes, and there were coarse fibrillations of the calf and thigh muscles. There was a spinal subarachnoid block at the first lumbar interspace. Operation revealed a dermoid cyst, 5.5 cm. long, filling the dural sac and attached to the conus and filum terminale. Convalescence was satisfactory.

Case 35.—P. Puech, A. Plichet, F. Visalli, and M. Brun,[34] 1936: A male, age 37, had had difficulty in walking for one year. There were sensory changes in the legs for a shorter period. Finally vesicorectal incontinence and genital changes were noted. An intramedullary dermoid at the sixth and seventh thoracic segments was curetted, 4 Gm. of material being removed. The capsule was thin or absent throughout. The postoperative course was satisfactory.

Case 36.—J. G. Love and J. W. Kernohan,[24] 1936: A male, age 40, complained of leg weakness and incontinence for an unstated period of time. A dermoid cyst was found "in the conus medullaris and filum terminale." It was evacuated. Convalescence was uneventful, but the neurological condition was essentially unchanged.

Case 37.—R. A. Varshaver,[44] 1937: The description of this intradural cholesteatoma is not available.

We have omitted two cases cited by Steinke[41] (1918) because information supplied does not allow us to determine that these cases have not been already included in our reports.

The appended cases have been studied by us.

Case 38.—No. 16270, R. V. H.: Male, age 17, was admitted complaining of having had bilateral "sciatica" for several years; lumbar pain for 15 months; complete right leg paralysis and paresis of the left leg for three to four months; recent fecal incontinence and urinary retention.

Physical Examination demonstrated absent knee jerks, atrophy and absent faradic response in the right peronei; contractures in the right foot, priapism, and anesthesia over the legs, backs of thighs, buttocks and perianal regions.

Operation.—An intradural tumor, lying between the second and fourth lumbar vertebrae, was only partly removable. It was described by Professor Adami as an "epithelial inclusion cyst of the spinal canal within the dura mater." Microscopic examination leaves no doubt, however, but that it was an epidermoid cyst.

The postoperative course was satisfactory but the symptoms were not alleviated. This case, found in 1908, Dr. C. K. Russel kindly allows us to present.

Case 39.—No. 5374-33, M. G. H.: Male, age 45, was admitted to the "M" service of the Montreal General Hospital complaining of fecal incontinence, urinary frequency for six years, and ulceration of the buttocks for two weeks. The onset of symptoms immediately followed removal of an "anal fistula" and left herniotomy and orchidectomy. Perineal and leg numbness were noted while still convalescing; genital anesthesia was first observed three weeks afterwards. A few weeks later difficulty in complete bowel and bladder evacuation appeared. There was likewise disturbance of sexual function.

Four years before the present admission, there was twitching of the leg muscles on fatigue. More recently this had been intermittent regardless of activity. During the last 18 months, he had had leg weakness, urinary frequency, dribbling, and fecal incontinence after cathartics. The immediate cause for seeking relief was the appearance of the rapidly spreading ulcers on the buttocks.

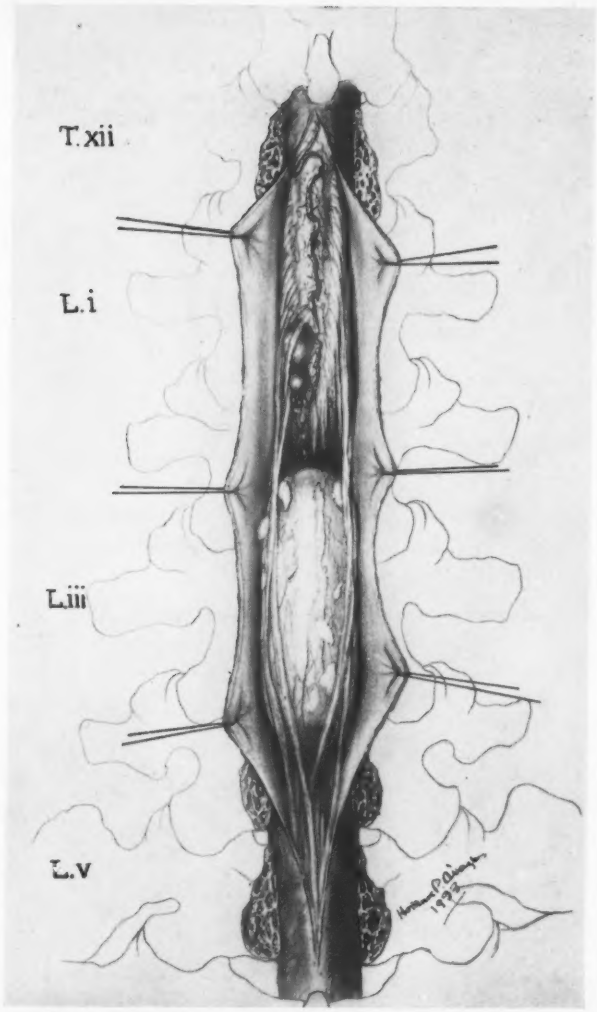

FIG. 1.—Case 39: Dermoid cyst of the cauda equina in situ. The cyst and conus medullare are represented about one segment too high in this drawing.

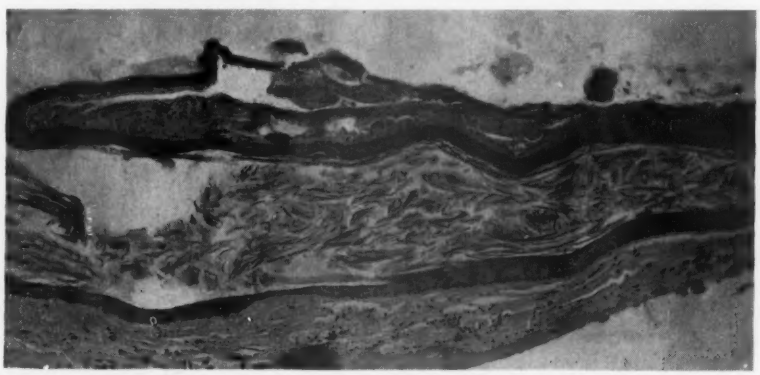

FIG. 2.—Case 39: Section through the wall of the cyst showing desquamated material in the lumen.

Physical Examination demonstrated pressure sores on each buttock; a greatly distended bladder; complete cutaneous anesthesia in the third, fourth and fifth sacral segments; partial cutaneous anesthesia in the first and second sacral segments; atrophy and fibrillary twitchings of leg muscles; and slight increase of "tone" in the left leg. Deep reflexes in the legs were hyperactive. The cremasteric reflex was present. Lumbar punctures were performed with the results as charted (Table I).

TABLE I

RESULTS OF LUMBAR PUNCTURES

Lumbar Interspace	September 15	September 22	September 27	September 28
1.....	Normal	Not tested	Complete block	Complete block
2.....	Dry tap	Partial block	One drop of creamy material*	Partial block
3.....	Normal	Complete block	Complete block	Complete block
4.....	Normal	Not tested	Not tested	Not tested
5.....	Normal	Not tested	Not tested	Not tested

* Smears made of the turbid substance obtained September 27 showed an occasional cell shadow in an amorphous material.

Operation.—Laminectomy was performed. Beneath the third and fourth lumbar laminae was an oval-shaped, yellowish mass, 5x3 cm. in size, anchored among the posterior roots of the cauda equina by thin membranous attachments (Fig. 1).

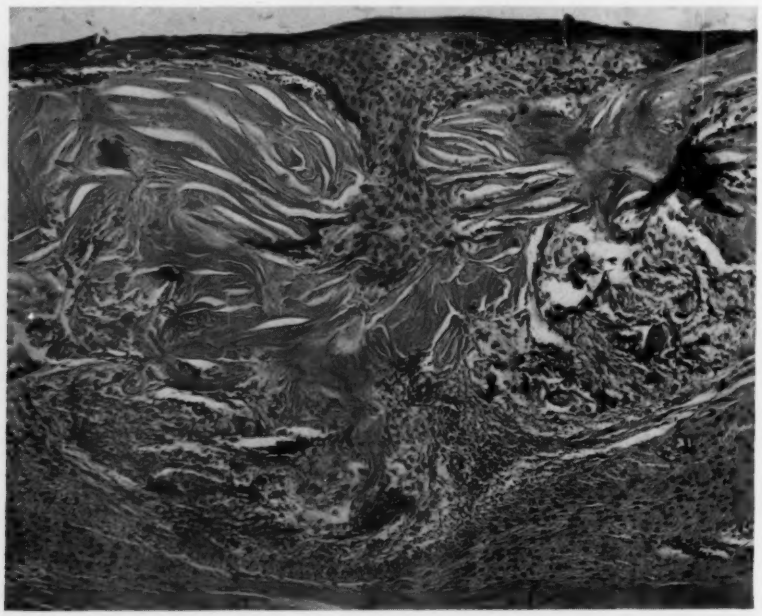

FIG. 3.—Case 39: Section showing epidermis and hyalinized connective tissue beneath.

Operative Pathology.—The tumor consisted of a soft, cheesy material in a thin, translucent capsule, on the outside of which clung flakes of a similar substance. Between this cyst and the conus medullaris was a greenish cord, irregularly cystic, forming a bulbous swelling against the side and tip of the conus. It adhered to the upper two-thirds of the tumor. The tumor and cystic cord were completely removed.

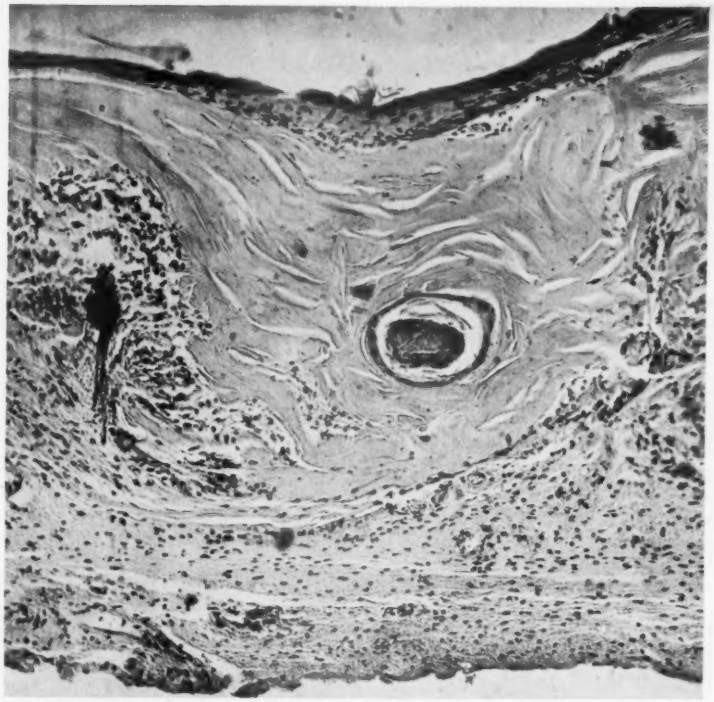

FIG. 4.—Case 39: Section through cyst wall showing a hair follicle in hyalinized subepidermal connective tissue.

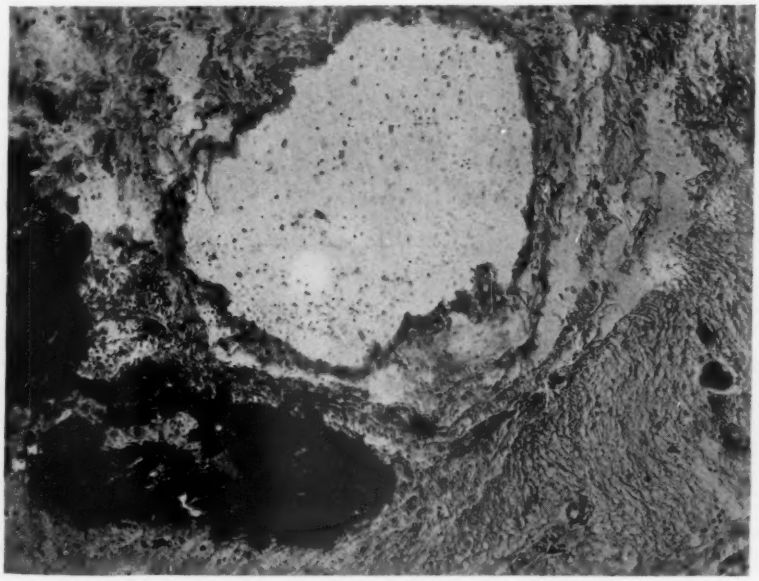

FIG. 5.—Case 39: Section through ventriculus terminalis.

The postoperative course was uneventful. A year later there was still vesicorectal incontinence, weakness and anesthesia corresponding with the complete level on admission.

Pathologic Examination.—Microscopic: The main tumor is a typical dermoid cyst, with walls of stratified squamous epithelium and containing hair, sebaceous material, and sheets of desquamated stratified keratin (Fig. 2). The epidermis lies upon a thin bed of fibrous connective tissue which is hyalinized in some regions (Fig. 3). One hair follicle has been seen in cross-section (Fig. 4).

The cystic cord is chiefly composed of loose glial tissue, the cells resembling small astrocytes. An occasional large astrocyte and nerve cell is to be seen. Corpora amylacea are present. A large empty cyst, representing the ventriculus terminalis (Kernohan,[22] 1924), is eccentrically placed in this tissue. It is lined by layers of poorly preserved ependymal cells on a connective tissue substratum. Immediately beneath the ependyma, macrophages containing yellow pigment lie in an interrupted sheet.

Sections taken further caudad show a general structure of medullary tissue and a narrowed cystic cavity representing central canal or ventriculus terminalis (Fig. 5). Corpora amylacea are surrounded by pigmented macrophages. Glial tissue wraps about the ependymal cavity to form the general shape and structure of the spinal medulla.

Case 40.—No. 2304, M. N. I.: The parents of this male child, age 2½, noticed a pigmented, elevated spot over the lumbosacral spine shortly after birth. Nine months before admission a discharge appeared at this point and continued intermittently until admission. For five months before admission, attacks of chills, fever, opisthotonos and vomiting occurred at two to three week intervals. The appearance was of recurring meningeal irritation. When admitted he had already had a right-sided hernial repair.

When first seen he lay with his legs drawn up and resented any attempt to extend them. He had neck stiffness and bilateral absence of ankle jerks. Pus could be expressed from the draining sinus in the lumbosacral region.

Operation.—A dermoid cyst was found filling approximately two-thirds of the vertebral canal. It lay between the conus, at the twelfth thoracic vertebra level and the second sacral spine. Though subdural, it connected with the skin surface, through a spina bifida of the fifth lumbar vertebra, by means of the sinus tract. It was opened and was found to contain cheesy material, hair and pus, in which were numerous gram-positive cocci. Patches of purulent exudate were found all along the subarachnoid space as high as the ninth thoracic vertebra. Lower down, pus was also found epidurally and subdurally.

The right side of the conus continued, for several centimeters, as a greenish core of homogeneous tissue—apparently an extension of the spinal cord.

Many of the roots forming the cauda equina were so intimately adherent to the wall of the cyst that only a subtotal removal was possible. Due to the infection, a stormy convalescence followed, but he was discharged in a plaster corset four and one-half months later.

Pathologic Examination.—The removed tissue was seen to consist of stratified squamous epithelium, flakes of keratin, amorphous débris, and gram-positive cocci among numerous polymorphonuclear leukocytes. *Diagnosis*: Dermoid cyst, infected.

Discussion of Cases Presented.—Though the actual removal was successful, each of our patients has persisting sequelae. In each instance, the dermoid lay among the roots of the cauda equina. Two of our patients had had an inguinal hernia operated upon before the dermoid was discovered. Twice the cyst was attached to the end of the cord.

In our second case, we were unable to identify any continuation of the filum caudal to the dermoid. Cephalad, the filum was cystic and separable from the conus by a line of cleavage. The ependymal cysts and transition from fibroblastic into glial tissue in this case are important pathologically.

Clinical interest centers about the fortuitous needle biopsy and inconstant subarachnoid block. As to pathogenesis, we feel that the "anal fistula" must be assumed to have been a pilonidal cyst and part of the original cord of epithelium from which the dermoid was separated. Radical excision of this pilonidal cyst released intravertebral attachments. Thereafter, the growing dermoid suspended from the cord possibly tugged on the conus and produced the symptoms by repeated cord injury. The tumor, therefore, represents the original point of attachment of the filum to the skin, from which it was separated in the normal growth processes. This theorization has adequate support in the work and writings of embryologists as Streeter[42] (1919), Keith[21] (1933), Jordan and Kindred[20] (1926) and Frazer[13] (1931).

The cystic connection between cord and dermoid seems analogous to the vestige particularly described by Frazer, who states that part of the coccygeal cord is carried up on the conus to form a small addendum containing the distorted remains of the central canal. Bearing this observation in mind, the gradual transition from glial tissue into the connective tissue of the cyst wall assumes unique significance.

The features of the third case are the associated infected sinus and the spina bifida. The fact that this dermoid extended to the skin as an ectodermal sinus relates it to the dermal sinuses as described by Walker and Bucy[46] (1934). We agree that these sinuses and the dermoids are but stages in the same developmental anomaly.

Discussion.—Of these 40 patients, 21 were male, 16 were female and in three, the sex was not mentioned. The age at discovery, by decades, was: first decade, six cases; second decade, four cases; third decade, eight cases; fourth decade, 11 cases; fifth decade, five cases; sixth and seventh decades, four cases; unknown, two cases. The age at onset of symptoms was: first decade, eight cases; second decade, eight cases; third decade, ten cases; fourth decade, seven cases; fifth and sixth decades, five cases; unknown, two cases. The extreme ages at discovery range from birth (an anencephalic monster) to 62 years. The period of symptoms varies from two weeks to 19 years. A long history is more common. Five patients had no symptoms or signs referable to the tumor.

The tumor size ranged from 17x12 cm. to tiny subpial growths of from 4 to 5 Mm. in diameter. Two patients had multiple cysts. Of the tumors where meningeal position is mentioned, two were extradural, 13 were subdural, 13 were subarachnoid and nine were subpial. Twenty-nine of the solitary cysts were below the level of the sixth thoracic vertebral body. All or part of 20, were in the lumbosacral region. Of the 24 patients operated upon, 19 recovered. Three of these had a recurrence, discovered in one and one-half, three, and six years, respectively. In eight instances, including the three with recurrence, the cyst could not be completely removed because of its peripheral attachments.

Associated conditions have included anencephaly, Hodgkin's disease, encephalitis, influenza, intracranial dermoids, neuro-epithelioma, spina bifida,

pilonidal cyst, infected sinus tract, dilatation of the vertebral canal (three cases), inguinal hernia, and sarcoma of the kidney. All but the last were connected in some way with the tumor and its diagnosis. From this information we conclude that apparently some anomaly of growth may occur which leaves ectodermal cell rests in such a position that the cyst resulting from their proliferation may lie anywhere between the central canal of the spinal cord and the skin surface. Symptoms usually appear before the fortieth year, and most frequently point to a slowly expanding lesion in the lumbosacral segments of the vertebral canal. Sharp, shooting pains in the leg, often circumscribed in extent, are a frequent cause of complaint. Important associated findings in such patients are spina bifida, lumbosacral dimple, and inguinal hernia. The diagnostic importance of a midline lumbosacral or pilonidal sinus is to be emphasized. When such cysts are found at operation their potential multiplicity and tendency to recur if incompletely removed, must be borne in mind.

SUMMARY

(1) A review and discussion of the literature, including 37 cases of dermoid cyst of the vertebral canal, is made. Three cases are added.

(2) These cysts produce symptoms of slowly progressive spinal cord compression beginning usually in the second, third or fourth decade of life. They may be present at birth or may not give trouble till the sixth decade.

(3) Spinal dermoids have a wide range of size. They may be multiple. They may appear anywhere between the central canal of the spinal cord and the skin surface, and usually are in the lumbosacral region. They may dilate the bony canal. They may be related to dermal sinuses and pilonidal cysts of the coccygeal region. Inguinal hernia may be associated with cysts in the cauda equina.

(4) Removal must often be incomplete. Therefore, recurrence is not infrequent.

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SPINAL EXTRADURAL CYST ASSOCIATED WITH KYPHOSIS DORSALIS JUVENILIS

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SPINAL extradural cysts are sufficiently rare and the results of their operative removal are so gratifying that further discussion of this interesting lesion seems warranted. Elsberg, Dyke, and Brewer[1] were the first to describe this lesion, reporting four cases, in 1934. Their search of the literature failed to reveal a single instance of a similar case on record, although Lehman,[2] one year later, added two additional cases and was able to find reports of three other instances of extradural cysts, only two of which probably fall into the group under discussion. Cloward and Bucy[3] were the first to recognize and point out the relationship of extradural cyst as an etiologic factor in the production of bony changes within the spine characteristic of and identical with those occurring in kyphosis dorsalis juvenilis (the rounded humpback of adolescence). In their article, which appeared in 1937, they cited nine other proved cases of spinal extradural cyst in addition to the one they reported, and found one other, unproved and unrecognized case, originally reported by Blum. Since the publication of their paper an additional case has been reported by Kelly.[5]

In the present communication we wish to report a case of spinal extradural cyst associated with changes within the spine identical with those described by Cloward and Bucy.[3]

Case Report.—H. H., colored, male, age 14, was referred from the Orthopedic Clinic of the James Walker Memorial Hospital, Wilmington, N. C., by Dr. Alonzo Myers of Charlotte, N. C. He was admitted to the James Walker Memorial Hospital, December 18, 1937.

Six months prior to admission the child first noticed weakness and stiffness of the right leg which gradually spread to involve the left leg and within two months had progressed into a complete spastic paraplegia. No history of trauma could be elicited. At no time had there been any pain, and the child was aware of no subjective change of sensation; although at the first examination a superficially infected, second degree burn was found over the left hip, which caused no pain at the time of its occurrence three weeks prior to admission. There had been no disturbance in the control of either the vesical or rectal sphincters. The general health of the child had been good and there was no history of recent illnesses or infections. He had received no medical attention prior to admission to the local hospital.

Examination.—The child was an illiterate but cheerful, well-nourished and well-developed Negro boy. The temperature, pulse, respiration, and blood pressure were all within normal limits. General physical examination showed the head, neck, lungs, heart, and abdominal viscera to be normal. The spine was in good alignment and no evidence of a rounded dorsal kyphosis could be demonstrated.

Neurologic examination revealed the cranial nerves to be intact. The musculature and strength of the upper extremities were normal and their deep tendon reflexes were

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present and bilaterally equal. Hypesthesia was present below the level of the anterior iliac spines, the perception of light touch and pin-prick being diminished below this level. There was no "saddle area" of anesthesia. Kinesthetic proprioception and position-sense were completely absent in the lower extremities. There was motor paralysis of both lower extremities with marked spasticity. No muscle atrophy was discernible, but early contracture deformity was beginning to become evident. A mass reflex response could be elicited on painful stimulation. The deep tendon reflexes were markedly exaggerated and there was well-sustained clonus both at the ankle and patella. A positive Babinski sign was present bilaterally.

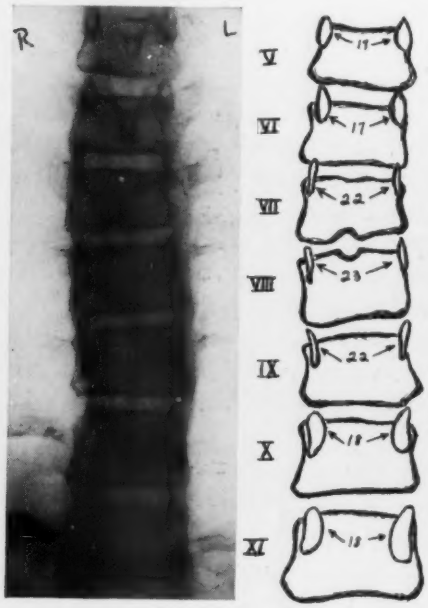

FIG. 1*a*.—Anteroposterior view of the dorsal spine. Note the thinning of the pedicles of the seventh, eighth, and ninth vertebrae, with a corresponding dilatation of the spinal canal. The disk between the seventh and eighth vertebrae has ruptured into their bodies.

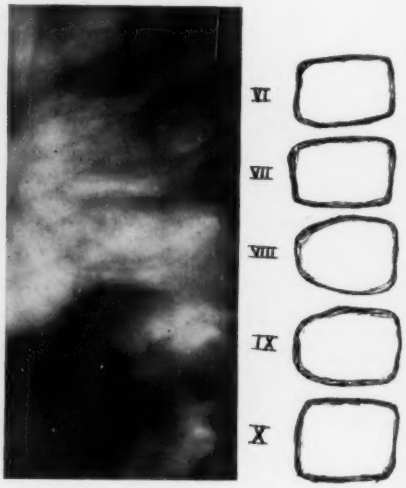

FIG. 1*b*.—Lateral view of the dorsal spine. The reproduction is not as clear as the original film, but a rounding off of the anterior superior and anterior inferior borders of the eighth and ninth vertebral bodies can be seen.

Spinal puncture between the third and fourth lumbar vertebrae revealed clear, colorless fluid under an initial pressure of 70 Mm. of water. There was no manometric rise on jugular compression, but a sharp response was elicited on firm abdominal pressure. The spinal fluid contained 15 lymphocytes and assayed a total protein content of 200 Mg. per 100 cc. of fluid.

Roentgenograms of the spine showed a slight, right lateral scoliosis in the mid-dorsal region (Fig. 1*a*). The laminae of the seventh, eighth, and ninth dorsal vertebrae were thin and their corresponding pedicles were markedly eroded and flattened on their medial surfaces. The spinal canal was somewhat dilated between the levels of the seventh and ninth dorsal vertebrae, inclusive. The transverse diameter, as measured by the interpedicular space, reached a maximum of 23 Mm., whereas the space immediately above and below this dilatation measured only 17 Mm. and 18 Mm., respectively. The intervertebral space between the seventh and eighth dorsal vertebrae was somewhat narrowed and there was evidence of rupture of this disk into the contiguous vertebral bodies. In the lateral view (Fig. 1*b*) the contour of the spine was normal. The anterior superior

and anterior inferior borders of the bodies of the eighth and ninth dorsal vertebrae were rounded and indistinct, but definite wedging of the bodies could not be demonstrated.

Diagnosis.—It was plainly evident that we were dealing with cord compression, most likely due to an expanding neoplasm in the mid thoracic region.

Operation.—December 21, 1937: Under avertin and ether anesthesia, the laminae of D IX, D X, and D XI were exposed and removed. This brought into view a thin-walled cyst which bulged down from under the eighth neural arch, filling the spinal canal entirely from side to side. The cyst was easily pulled down from under the arch and was found to be attached to the dura by a single narrow pedicle arising from the dorsal surface of the dura near the exit of one of the posterior roots. The pedicle was cut between silk ligatures and the cyst removed. This left a greatly dilated spinal canal and the laminae over this area were seen to be very thin. The cyst was roughly the shape

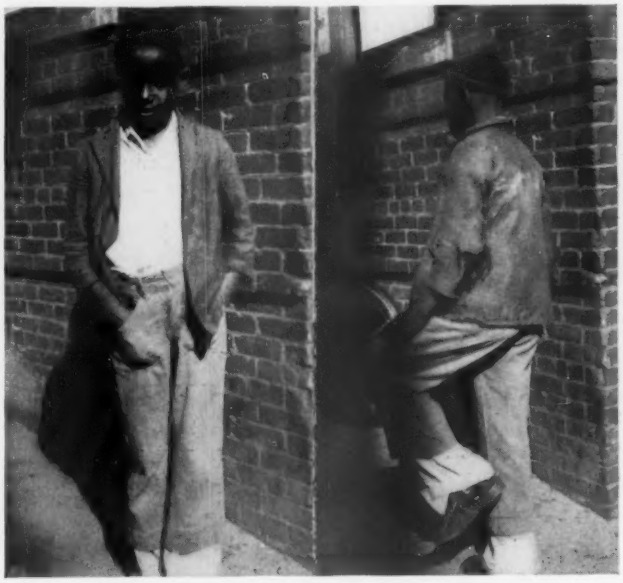

FIG. 2.—The patient three and one-half months after operation. Note the ability to stand on one leg unsupported, and the erectness of the spine.

of an egg and measured approximately 3x4 cm. Its wall was thin and translucent and contained clear, colorless fluid. Microscopically, the cyst wall was composed of thin avascular fibrous tissue lined with a single layer of flattened epithelium similar to that of the arachnoid membrane.

Postoperative Course.—Convalescence was smooth, and on the third postoperative day function began to appear in both legs, and thereafter strength and motion rapidly returned. A body encasement was applied with the spine in hyperextension and the patient was discharged, January 12, 1938, 22 days after operation. At this time the child was able to stand and walk with assistance.

Subsequent Examinations.—April 5, 1938: "The child walks with a normal gait. Muscle tone normal. Position-sense good. Sensation normal. Tendon reflexes hyperactive, and there is still unsustained ankle clonus. The plantar response is down."

June 25, 1938: "Normal muscular strength. Romberg negative. Knee jerks normal. No clonus. Abdominal and cremasteric reflexes active. Carriage is erect and the spine is of normal contour."

Discussion.—The clinical picture of spinal extradural cyst is remarkably constant and this feature has been emphasized in every article that has appeared on the subject. The lesion usually appears in adolescent boys between the ages of 12 and 16, but it is not unknown in girls. The cysts seem to have a predilection for the dorsal region, the majority arising from the dura in the midthoracic area usually between the sixth and ninth dorsal vertebrae. Just why they should arise in this region is not entirely clear, and we have no plausible explanation to offer. Elsberg, Dyke, and Brewer[1] advance the hypothesis that the cysts may arise either as a congenital diverticulum from the dura mater or as a herniation of the arachnoid through a defect in the dura. Cloward and Bucy[3] conclude from their microscopic examination of the cyst wall that there is more evidence to support the diverticular origin, although Kelly[5] favors the herniation theory. Direct communication between the cyst and the subarachnoid space has been demonstrated.[2, 6] Unfortunately, the pedicle in the present case was ligated before its connection with the dura was severed and a communication with the subarachnoid space was not shown. Microscopically, the cyst wall is composed of avascular collagenous fibrous tissue and its inner surface is lined by a single layer of flattened epithelium similar to the arachnoid membrane. It thus seems to contain the elements common to both the dura and arachnoid.

The symptoms of spinal extradural cyst are largely those of any other tumor encroaching upon the cord and giving rise to signs of cord compression. Weakness and spasticity of one or both legs are usually the first symptoms to appear, which gradually progress into a severe spastic paraplegia. Pain is usually strikingly absent. This seems strange since most of the cysts arise from or near the exit of one of the posterior nerve roots. This seeming paradox is probably best explained by the nature of the tumor itself; the soft, easily adaptable encysted fluid causes very little irritation and hence gives rise to no irritative phenomena. The tracts lying in the dorsal column of the cord are usually severely affected. Loss of position and kinesthetic sense is the usual rule, whereas the epicritic sense is usually less seriously involved. Loss of sphincter control is rare, as one would expect from the location of the tumor in the thoracic region. Sphincter disturbances are late manifestations and usually indicate severe cord damage.

The striking features on examination are the signs that usually accompany cord compression and pyramidal tract involvement, *i.e.*, spastic paraplegia, hyperactive knee and ankle jerks, sustained clonus, and a positive Babinski sign. The deep sensibilities are severely impaired and the position-sense is usually absent. Cutaneous sensation to light touch, pin-prick, heat and cold is usually diminished below the segmental level of the lesion, but the changes are usually minimal unless the lesion is of long duration.

Lumbar puncture may or may not show a complete block. Even if the subarachnoid space is completely occluded, as pointed out by Cloward and Bucy,[3] there may be a manometric rise on jugular compression due to the

pressure transmission quality of the fluid tumor. In these instances, however, lipiodol injection will demonstrate the block. The spinal fluid may be clear or xanthochromic, depending upon the completion and duration of the block. The total protein content of the spinal fluid is usually increased and in some instances may be quite high (200 mg. per cent in the case herein reported).

In the roentgenograms the most striking changes are demonstrated. Changes within the neural arch are the earliest to appear and later manifest themselves in the bodies of the vertebrae. Elsberg, Dyke, and Brewer[1] focused attention on the broadening of the spinal canal at the site of the intraspinal lesion as measured by the transverse interpedicular diameter. The medial surfaces of the pedicles are flattened or concave and the thickness of the pedicles is greatly reduced. The overlying laminae are likewise thin and eroded. The bodies of the vertebrae in the lateral views, as was first demonstrated by Cloward,[4] may show concavity of the posterior surfaces with broadening of the spinal canal. Other changes within the vertebral body characteristic of those seen in kyphosis dorsalis juvenilis are usually an accompaniment of these extradural cysts. The earliest change demonstrable is an erosion or rounding off of the anterior superior and anterior inferior corners of the vertebral bodies, as described by Scheurmann.[6] As the process progresses the intervertebral disk may rupture into the bodies and the involved vertebrae may collapse anteriorly giving rise to a rounded kyphosis. Cloward and Bucy[3] were the first to recognize that the changes occurring within the vertebral bodies in cases of extradural spinal cyst were identical with those occurring in kyphosis dorsalis juvenilis. They surmised that these vertebral changes were secondary to the presence of the intraspinal cyst, and advanced the hypothesis that the destruction of the vertebral body was the result of venous stasis caused by compression and occlusion of the venous channels draining these bodies. If this theory is correct, then it is reasonable to assume that this destructive process ceases to exist upon the removal of the cyst and that kyphosis if not present should not develop; and if it already exists its progress should be arrested provided adequate protection is given the spine during the period of reconstructive healing, either in the form of plaster jacket or spinal fusion. Further reports and observation of cases will prove or disprove this theory.

SUMMARY.—A case of spinal extradural cyst, occurring in a 14-year-old Negro boy, is presented. The cyst, containing clear fluid and lined by flattened epithelium, arose from the dura by a thin pedicle near a posterior nerve root in the midthoracic region. It was accompanied by spastic paraplegia and was associated with erosion of the neural arches, broadening of the spinal canal, and changes within the vertebral bodies identical with those occurring in kyphosis dorsalis juvenilis. Complete recovery resulted from its operative removal. A brief discussion of the symptomatology and pathology is presented.

CONCLUSIONS

(1) Paraplegia in an adolescent, associated with broadening of the neural canal and erosion of the vertebral bodies in the midthoracic region, as described by Elsberg, Dyke, and Brewer,[1] and Cloward and Bucy,[3] is pathognomonic of spinal extradural cyst.

(2) There is more evidence that spinal extradural cyst arises as a true meningeal diverticulum rather than as a herniation of the arachnoid through a defect in the dura.

(3) The theory, advanced by Cloward and Bucy,[3] that the destruction of the vertebral body results from venous stasis secondary to the presence of the intraspinal cyst appears to be tenable.

(4) Excellent results can be expected from the early recognition and prompt operative removal of the cyst.

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[6] Quoted from Cloward and Bucy.[3]

POSTOPERATIVE TEMPERATURE REACTIONS: REDUCTIONS OBTAINED BY STERILIZING THE AIR WITH BACTERICIDAL RADIANT ENERGY*

SEASONAL VARIATIONS

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WITH the introduction of sterilization of the air into our operating rooms, there was a striking improvement in postoperative results;[1, 2, 3] namely:

(1) Lower postoperative temperature elevations.
(2) Shorter duration of postoperative temperature elevations.
(3) Reduction in the percentage of infections.
(4) Improved wound healing.
(5) Less severe systemic reactions.

It was soon noted that during the warmer months this improvement in regard to the elevation of temperature and the duration of elevated temperature following operation was not so good as had been the case during the cooler months. An analysis of 132 individual stages of extrapleural thoracoplasty, performed in a field of sterile air,[4] showed that during the warmer months (May 15 to October 15) the number of patients running a postoperative temperature above 38° C. (100.4° F.) increased to 49 per cent as compared to 28 per cent for the cooler months (October 15 to May 15) while the number of patients running a temperature elevation (above 37.5° C. [99.5° F.] or the preoperative level) for more than four days after operation, increased to 43 per cent as compared to 13 per cent during the cooler months.[4]

Before beginning sterilization of the air, it had been our impression that the best postoperative reactions occurred during the warmer months, at which time we knew the bacterial contamination of the air was low. It has already been reported that, in our occupied operating rooms, the number of pathogenic or other bacteria floating in the air is greater during the cooler than during the warmer months[2, 5] (Charts 1 and 2). Therefore, large operative procedures of choice were postponed until such a time. Naturally, with sterilization of the air we obtained the greatest improvement in our results during those periods when the air contamination was highest. We were surprised, however, to find that under this new condition, even though our results were improved throughout the entire year, our greatest postoperative reactions now occurred during the summer, at which time we had formerly obtained our best results. It soon became evident that some factor other than air contamina-

* Read before the Southern Surgical Association, White Sulphur Springs, W. Va., December 6, 7, 8, 1938.

tion came into play during the warmer months and was the cause of the greater postoperative temperature reactions occurring then.

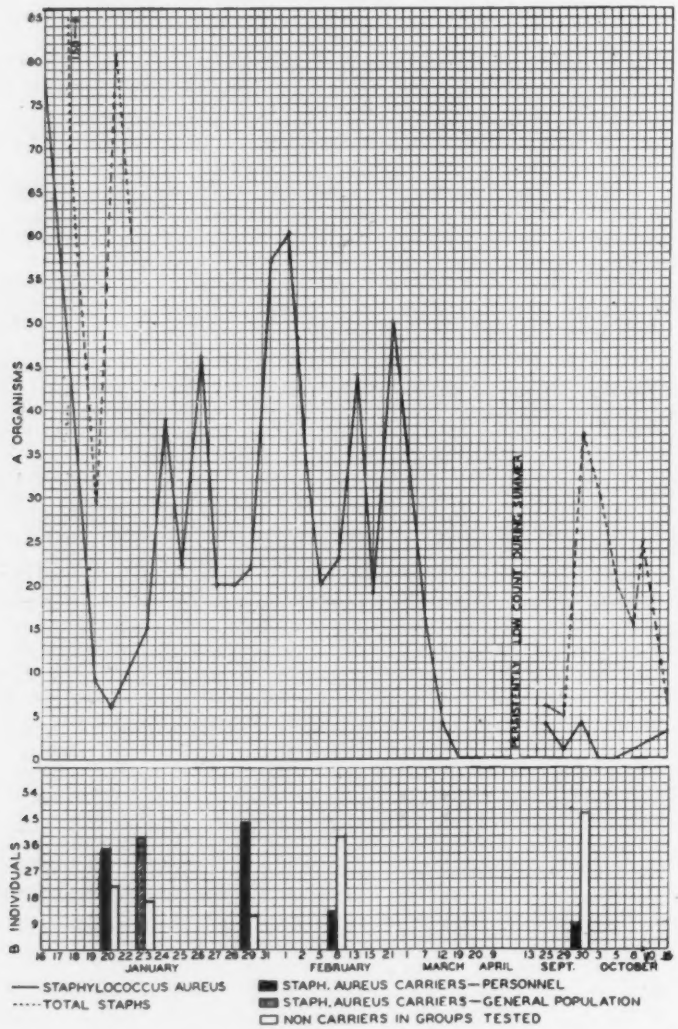

CHART 1.—(A) Contamination of the air of the occupied operation room predominantly with Staphylococci. The graph shows the number of colonies settling on a petri dish of blood agar per hour of exposure.

(B) Shows the number of carriers of Staphylococci (in the nose and throat) among the operating room personnel and in the general population.

Some reduction in the number of organisms in the air may have been brought about by care in cleaning, isolating and ventilating the rooms and by masking all individuals who entered. The greatest drop came with the warmer months, at which time there was a sharp decrease in the number of carriers. (Arch. Surg., 34, No. 5, 874, May, 1937).

On attempting to explain this, we thought of the possibility that during the warmer months it was more difficult for the patient to dissipate his body heat and consequently his body temperature might be higher. This may play a part but its rôle must be limited since there is no increased elevation before

operation or after the first few days following operation. It seems probable that perspiration may play an important rôle in washing organisms out of deeper, more protected parts of the skin, either by the normal flow or by massage and maceration of the wet skin, so that on a hot day the surface of the skin cannot be kept sterile for more than a few minutes (Fig. 1). This increases the likelihood of wound contamination from the skin of either the patient or some member of the operating team. The most severe and the only extensive infection that we have had in over 400 clean primary incisions performed in a field of sterile air occurred in the first stage of an extrapleural thoracoplasty and resulted from a tear in the operator's glove on a very hot

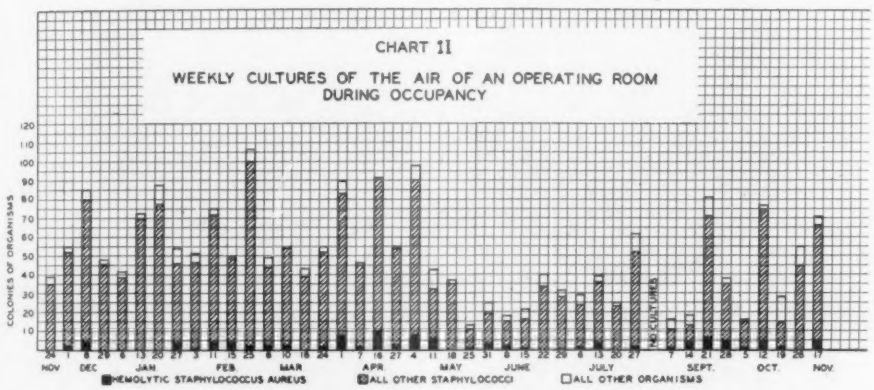

CHART 2.—Weekly cultures of the air of an operating room during occupancy. The cultures were made by exposing a petri dish of blood agar to sedimentation from the air for one hour. After incubating the plates for 48 hours, the colonies were identified and counted. Note the low total count and particularly the few hemolytic yellow Staphylococci during the warmer months. There was a close correlation between the intensity of the growth of these organisms in the noses and throats of the occupants of a room and the degree and type of bacterial contamination of the air in his room.

summer day. A large quantity of perspiration ran into the wound. Even though this was washed out immediately and as thoroughly as possible with sterile physiologic salt solution, the patient's temperature rose to 40° C. within 24 hours, and the wound became extensively infected. The patient recovered following adequate drainage.

In order to obtain a more accurate evaluation of the seasonal variations in the postoperative reaction of the patient as indicated by the temperature elevation and its duration, we analyzed three groups of patients. Some of each group had been operated upon with and some without radiation of the air. The temperature charts were taken as an index of the postoperative reaction since the clinical thermometer is a highly accurate instrument and the records were made by a large number of nurses who had no idea that they were to be used other than as an accurate record of the patient's course. Nothing was left to the interpretation of the doctor who might be prejudiced in favor of air sterilization.

GROUP I.—Extrapleural Thoracoplasties: These are taken since they are operations of great magnitude, with inevitable trauma; complete hemostasis

is difficult to obtain; it may not be possible to obliterate the dead space; and in our cases continuous catgut has been used for the buried sutures. The disadvantage of this type of case is that the temperature reaction may come from a stirring up, or an extension of the tuberculous process. However, this will usually be equalized in a large number of operations.

GROUP II.—Inguinal Herniorrhaphies: These are ideal in that they are clean incisions in otherwise healthy individuals. They are, however, small

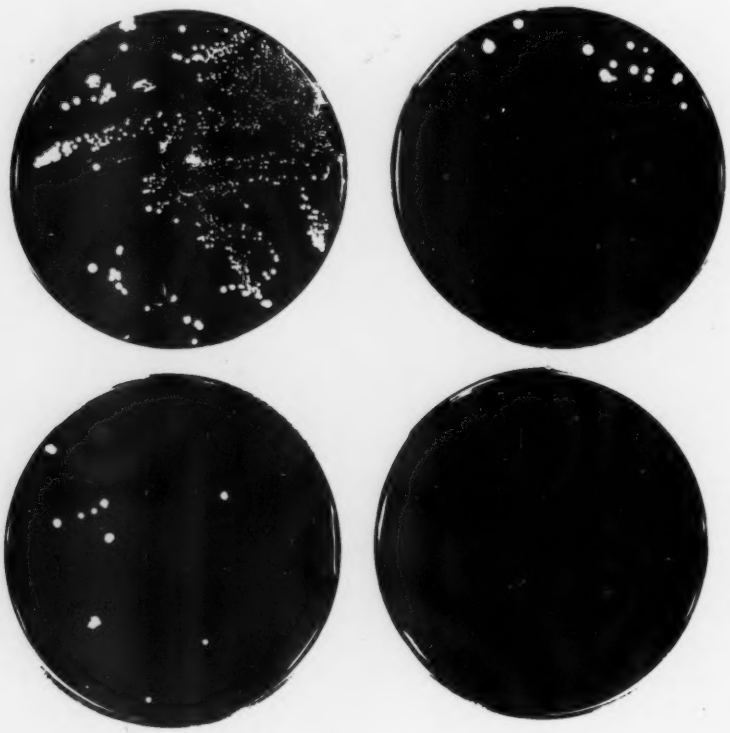

FIG. 1.—Photographs of one of many series of 48-hour cultures of perspiration made from the skin of the hands of four members of the operating team (or operative region). The organisms are predominantly white Staphylococci. Cultures of the hands made immediately following their preparation for the operation showed no growth.

operative procedures and should show little reaction or infection even without sterilization of the air (in our hospital 3.6 per cent, all mild[3]). In this group of cases, since this was not a planned experiment, but a review of operations already performed, most of the larger herniae in obese individuals are in the group with radiation. A higher percentage of the smaller herniae, in which infection is less likely to occur, are in the group without radiation. This should be kept in mind in interpreting the charts since one would expect the greater postoperative reaction following the larger operation. Also in this group with radiation two of the highest reactions occurred in two children of one and

one-half and two years of age, who had their hernia repaired under ether anesthesia (Charts 4 A, 7 A, and 10 A—June and July). It is our impression that very young children operated upon under ether anesthesia frequently run a relatively high postoperative temperature.

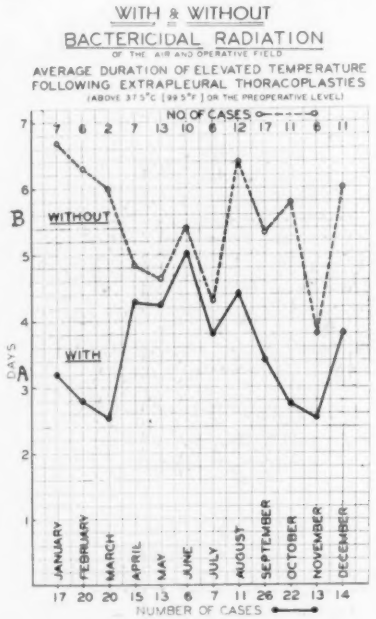

Chart 3.

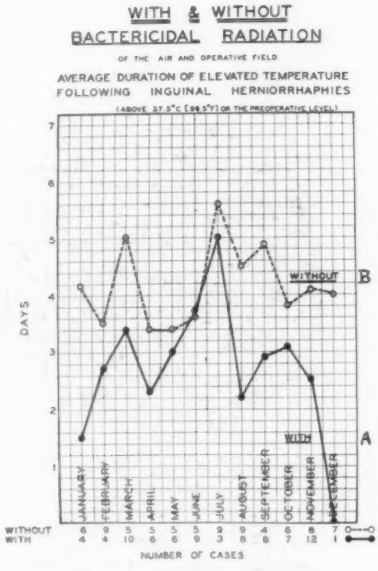

Chart 4.

Chart 3.—Average duration of elevated temperature following extrapleural thoracoplasties (recorded by month of operation). (A) With bactericidal radiation. (B) Without bactericidal radiation.

The following points should be noted in Charts 3, 4 and 5:

(1) With bactericidal radiation there was a reduction in the average duration of elevated temperature throughout the entire year.

(2) The reduction in the average duration of elevated temperature when the air was sterilized was greatest when the bacterial contamination was highest. (Compare A with B and correlate with Charts 1 and 2.)

(3) Without radiation the decrease in the average duration of postoperative temperature elevation during the warmer months was not as great as the drop in air contamination (Charts 1 and 2).

(4) With sterilization of the air the postoperative temperatures were of the longest average duration during the warmer months.

(5) Paragraphs three and four above, suggest that during the warmer months some condition other than air contamination enters the picture and causes the increased systemic temperature reaction. This condition may be the increase in the temperature and humidity of the surrounding air, but it seems more likely to be an increase in the wound contamination brought about by the bacteria in the perspiration resulting from this high temperature and humidity level.

Chart 4.—Average duration of elevated temperature following inguinal herniorrhaphies (recorded by month of operation). (A) With bactericidal radiation. (B) Without bactericidal radiation. See legend appended to Chart 3 for points of special interest.

Part of the higher average elevation and longer average duration of elevated temperature during June and July where radiation was used was caused by operations on two young children (one and a half years old for June and two years old for July), under ether anesthesia. Children of this age are more likely than adults to run a higher and longer temperature elevation following any operation under ether anesthesia. Part of the temperature reaction during February with radiation was caused by a postoperative parotitis.

Group III.—Radical Mastectomies: These form a very poor group for study since the operation leaves the skin flaps with a poor blood supply. As a result, the skin may slough and secondary surface infection may follow. In addition to this, three of the cases in which radiation was used showed ulceration before operation. These three cases had a mild infection in the incision following operation and these alone accounted for three of the higher tempera-

ture recordings noted in Charts 5 A, 8 A and 11 A (February, March and October). Such ulcerated cases were ruled out in statistical analyses for postoperative wound infections in clean primary operative incisions both in

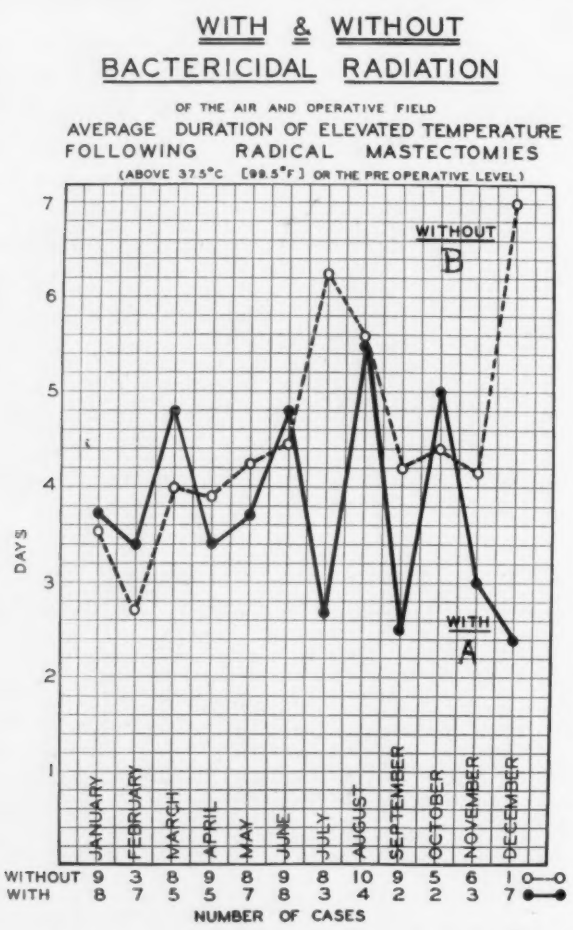

CHART 5.—Average duration of elevated temperature following radical mastectomies (recorded by month of operation). (A) With bactericidal radiation. (B) Without bactericidal radiation.

Note that for three months, February, March and October, the average temperature duration each month was increased for the group with radiation by one mild wound infection resulting from an ulcerated, infected tumor present at the time of operation. In curve B (without radiation) there was a very short average duration of elevated postoperative temperature during January, February and March, so this graph does not follow the curve shown in Chart 3. Radical mastectomy wounds are a poor selection for this study since, in addition to the cases showing ulceration before operation, the impaired blood supply in the large skin flaps may result in sloughing with the possibility of secondary, localized, superficial infection which may cause a low grade temperature reaction until healing is complete. Compare with Charts 3 and 4 and see legend appended to Chart 3 for points for special consideration.

the radiated and nonradiated groups. These ulcerated cases were, therefore, not included in previous reported statistics on operating room infections.

Each of the three groups of operations were divided into two series, one

including all operations performed in a field of sterile air and the other, all those performed without air sterilization.*

For both series of each group, every operation was recorded in the month during which it was performed. Three charts were made of each series, so arranged as to compare the results in series A, where bactericidal radiation was used, with the results in series B, where radiation was not used. For both series in each group, the charting by months shows at a glance the variations dependent on the time of year and a comparison of A with B in each group shows the relative improvement brought about by radiation of the air during each month of the year.

The average duration of elevated temperature following operation is shown by months for:

Group I	Extrapleural Thoracoplasties	A—with radiation B—without radiation	Chart 3
Group II	Inguinal Herniorrhaphies	A—with radiation B—without radiation	Chart 4
Group III	Radical Mastectomies	A—with radiation B—without radiation	Chart 5

The maximum temperature elevation for every case (highest point at, or above which there are more than two recordings) expressed in percentages of the total number of such operations performed under similar conditions during the month is shown by months for:

Group I	Extrapleural Thoracoplasties	A—with radiation B—without radiation	Chart 6 A, B
Group II	Inguinal Herniorrhaphies	A—with radiation B—without radiation	Chart 7 A, B
Group III	Radical Mastectomies	A—with radiation B—without radiation	Chart 8 A, B

In these charts each case is placed in the division (37°–37.5°, 37.6°–38°, 38.1°–38.5°, 38.6°–39° and 39°+ C.) in which it falls. The number of cases in each division is then expressed as a percentage of the total number of cases for the given month to give Charts 6, 7 and 8.

Every recorded temperature for eight days following operation (taken at four-hour intervals when the patient is running any elevation, otherwise every

* If there was any difference in the general operating room technic it was less rigid where air sterilization was used than where it was not used. This is particularly true of the thoracoplasty and mastectomy groups and applied especially to skin sterilization, masking, number of visitors allowed, time selected for operation, and the duration of occupancy of the room before operation. The question of difference in masking has been raised frequently. Two large gauze masks each eight thicknesses of butter gauze were worn over the nose and mouth during many of the thoracoplasties without radiation, while only one was worn, without other covering, for most of the thoracoplasties with radiation.

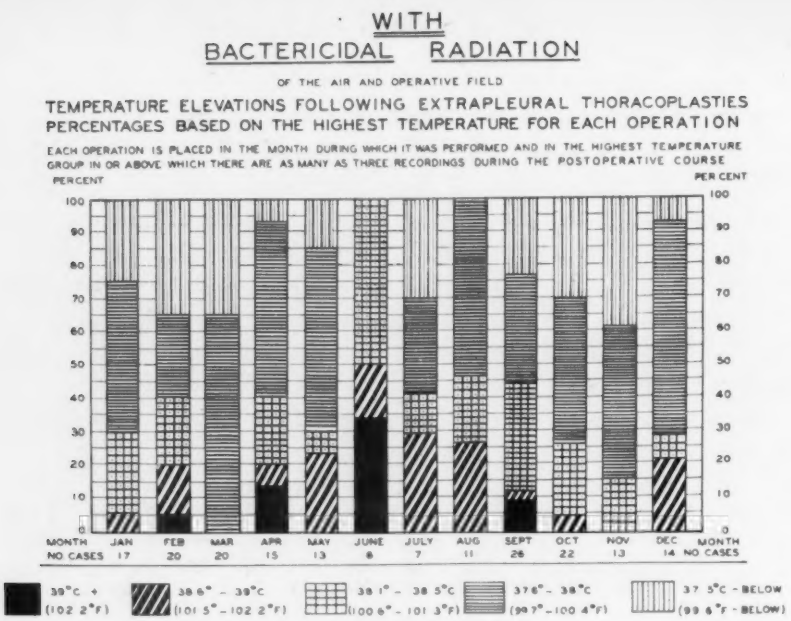

CHART 6A.

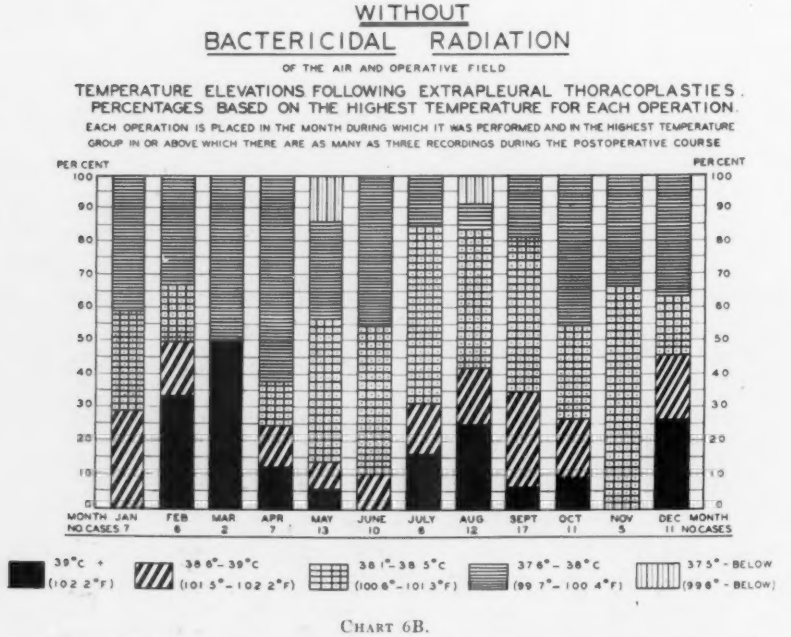

CHART 6B.

CHART 6.—Maximum temperature elevations following extrapleural thoracoplasties. (A) With bactericidal radiation. (B) Without bactericidal radiation.

Each operation is placed in the month during which it was performed and in the highest temperature group (37°–37.5°; 37.6°–38°; 38.1°–38.5°; 38.6°–39°; 39.1°+C.), in or above which there are as many as three recordings during the postoperative course. The number of cases in each temperature group is then expressed as a percentage of the total number of thoracoplasty operations performed during that month. This is done to facilitate comparisons, since the total for each month is 100 per cent regardless of the number of operations performed. The total number of cases on which the percentages are based is given beneath each month.

Special attention is called to the same five general points of interest in regard to the elevation of temperature in Charts 6, 7 and 8 as are given for the duration of temperature in the legend for Chart 3. (See legend for Chart 3, substituting average elevation for average duration of temperature).

WITH
BACTERICIDAL RADIATION

OF THE AIR AND OPERATIVE FIELD

TEMPERATURE ELEVATIONS FOLLOWING INGUINAL HERNIORRHAPHIES
PERCENTAGES BASED ON THE HIGHEST TEMPERATURE FOR EACH OPERATION

EACH OPERATION IS PLACED IN THE MONTH DURING WHICH IT WAS PERFORMED AND IN THE HIGHEST TEMPERATURE GROUP IN OR ABOVE WHICH THERE ARE AS MANY AS THREE RECORDINGS DURING THE POSTOPERATIVE COURSE.

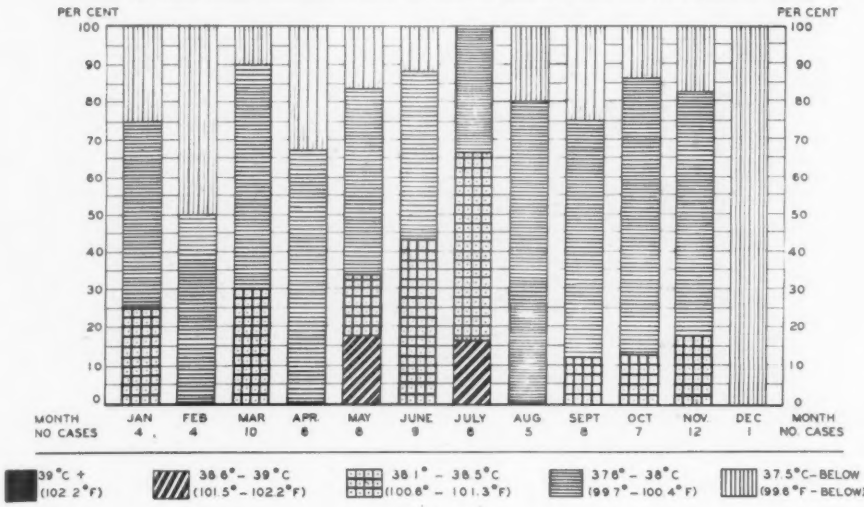

CHART 7A.

WITHOUT
BACTERICIDAL RADIATION

OF THE AIR AND OPERATIVE FIELD

TEMPERATURE ELEVATIONS FOLLOWING INGUINAL HERNIORRHAPHIES
PERCENTAGES BASED ON THE HIGHEST TEMPERATURE FOR EACH OPERATION.

EACH OPERATION IS PLACED IN THE MONTH DURING WHICH IT WAS PERFORMED AND IN THE HIGHEST TEMPERATURE GROUP IN OR ABOVE WHICH THERE ARE AS MANY AS THREE RECORDINGS DURING THE POSTOPERATIVE COURSE

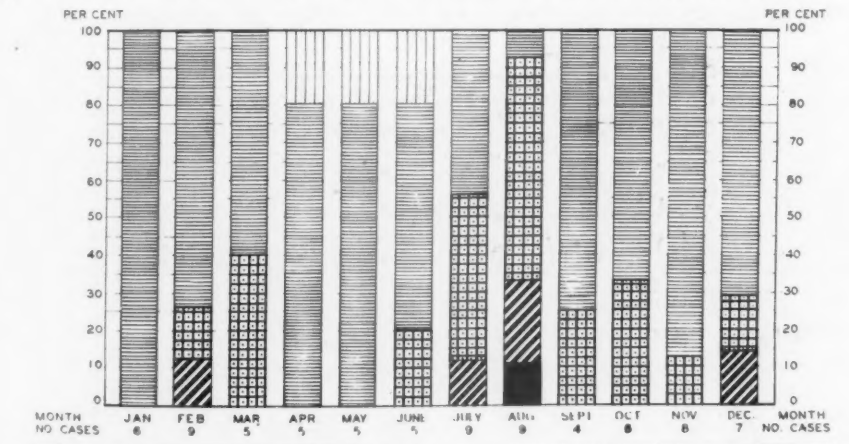

CHART 7B.

CHART 7.—Maximum temperature elevations following inguinal herniorrhaphies. (A) With bactericidal radiation. (B) Without bactericidal radiation.

The method used in making the chart and the reason therefor are given in the legend for Chart 6. The special points for consideration in regard to the elevation of temperature are similar to those given for the duration of temperature elevation in the legend to Chart 3. See legend to Chart 4 for note about higher temperatures on two small children operated upon during June and July, and one patient with postoperative parotitis operated upon in February.

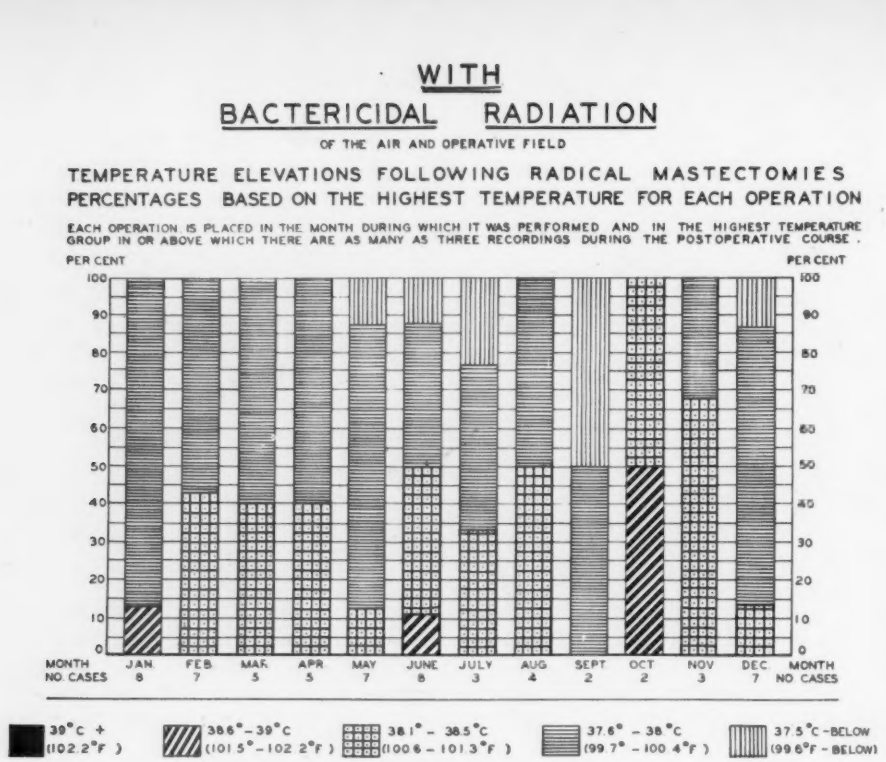

CHART 8A.

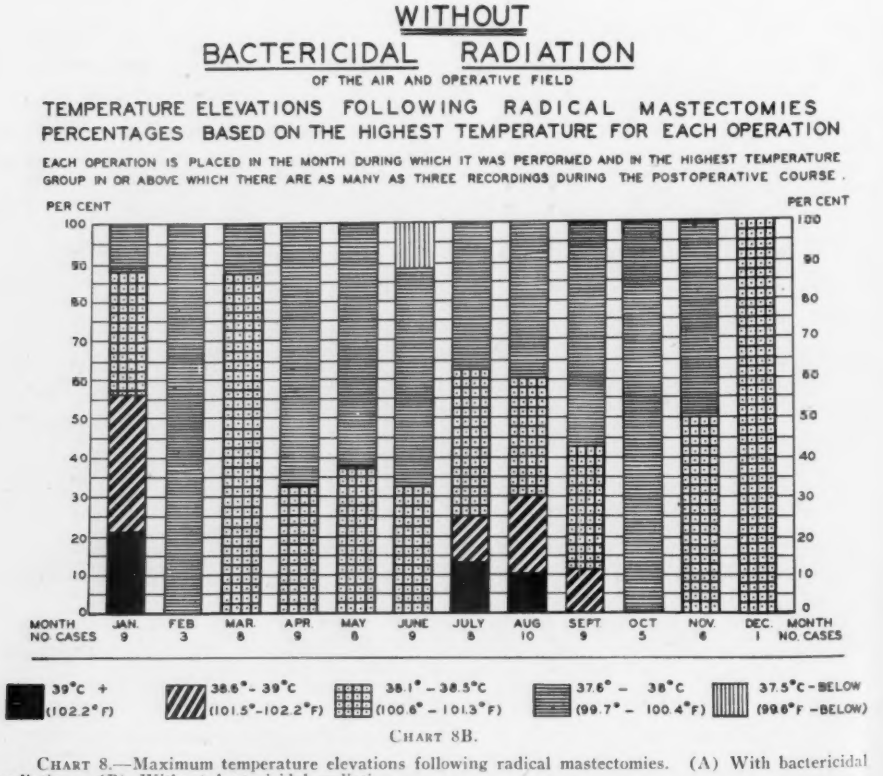

CHART 8B.

CHART 8.—Maximum temperature elevations following radical mastectomies. (A) With bactericidal radiation. (B) Without bactericidal radiation.

The method used in making the chart and the reason therefor are given in the legend for Chart 6. The points for special consideration in regard to the elevation of temperature are similar to those given for the duration of the temperature elevation in the legends to Charts 3 and 5.

four hours except at 12 midnight and 4 A.M. when the patient is sleeping) on every patient is shown by months for:

GROUP I	Extrapleural Thoracoplasties	A—with radiation	Chart 9 A, B
		B—without radiation	
GROUP II	Inguinal Herniorrhaphies	A—with radiation	Chart 10 A, B
		B—without radiation	
GROUP III	Radical Mastectomies	A—with radiation	Chart 11 A, B
		B—without radiation	

In preparing Charts 9, 10 and 11, every recorded temperature for eight days following operation was placed in the appropriate division (37°–37.5°, 37.6°–38°, 38.1°–38.5°, 38.6°–39° and 39°+ C.) and the total number of recordings in each division was then expressed as a percentage of the total such recordings for the given month. The total number of operations for each month is shown at the bottom of the charts.

EFFECT OF BACTERICIDAL RADIATION OF THE AIR

Without sterilization of the air, the average duration of the postoperative temperature elevation was longest when the air contamination was high and shortest when the air contamination was low. With sterilization of the air, there was a reduction in the average duration of elevated postoperative temperature roughly proportional to the degree of air contamination (compare A with B in Charts 3, 4 and 5 and correlate with Charts 1 and 2). There was a similar reduction in the average highest elevation of postoperative temperature (compare A with B in Charts 6, 7 and 8 and correlate with Charts 1 and 2), and in the height of the total temperature recordings for eight days following operations (compare A with B in Charts 9, 10 and 11 and correlate with Charts 1 and 2).

SEASONAL VARIATIONS IN THE POSTOPERATIVE TEMPERATURE REACTION

When bactericidal radiation was not used, the average duration of elevated temperature was definitely shorter during the earlier of the warmer months in extrapleural thoracoplasties, April through July, (Chart 3 B) and in inguinal herniorrhaphies, April through June, (Chart 4 B). Radical mastectomies (Chart 5 B) did not show such a drop since the curve was very low for January, February and March but it was also low during April, May and June as compared to July, August, and December. The charts showing the highest postoperative temperature elevations for each case (Charts 6 B, 7 B and 8 B) and those showing every temperature recording for eight days following operation (Charts 9 B, 10 B, and 11 B) have similar low recordings for the earlier warm months, April through June. All the charts (3 B through 11 B) showed a rise during the latter part of the warmer months.

With the introduction of sterilization of the air by bactericidal radiation, as noted above, there was little reduction in the temperature elevation and little shortening of the duration of elevation during these warmer months when

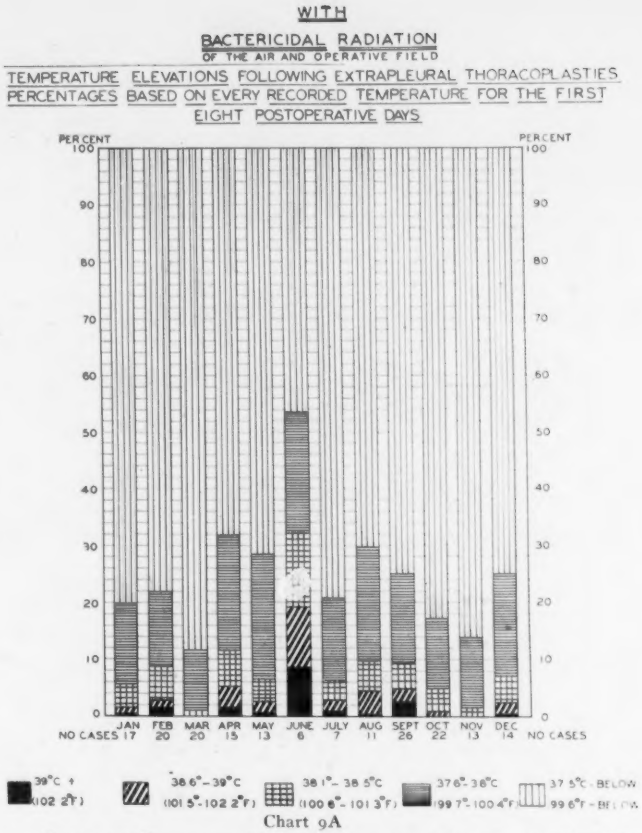

Chart 9A

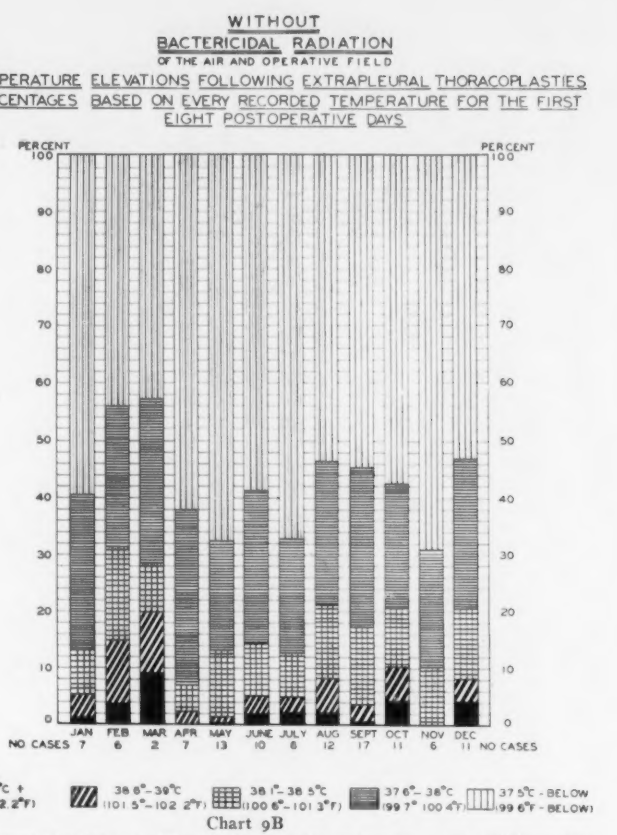

Chart 9B

CHART 9.—Every recorded temperature for eight days following extrapleural thoracoplasties. (A) With bactericidal radiation. (B) Without bactericidal radiation.

The percentages in this chart are based on every recorded temperature for eight days following operation (taken every four hours when the patient was running any elevation; otherwise, every four hours except at 12 midnight and 4 A.M., when sleeping). Every recorded temperature for eight days following operation was placed in the month during which the operation was performed and in the temperature group (37°–37.5°; 37.6°–38°; 38.1°–38.5°; 38.6°–39°; 39.1°+C.) in which it fell. The number of recordings in each temperature group was then expressed as a percentage of the total recordings in all the temperature groups for that particular month. Compare with Chart 6, where the percentages are based on the highest level reached during the postoperative course. This chart naturally shows a much higher percentage of normal temperatures than Chart 6. It does not cover more than eight days, since most temperatures are down to normal in less than that time. To cover a longer period would increase the percentage of the lower and diminish the percentage of the higher temperature groups. Attention is called to the same points of special interest as given in the legends for Charts 3 and 6.

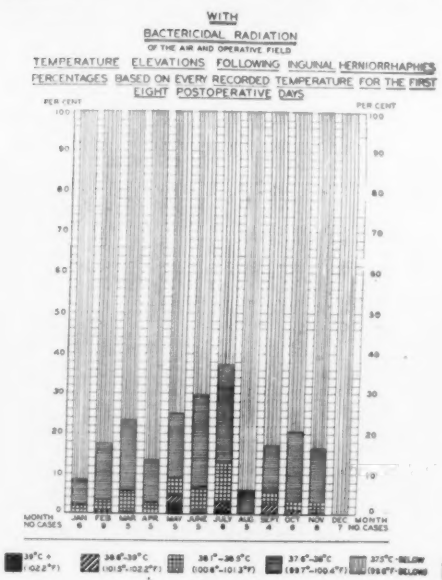

Chart 10A

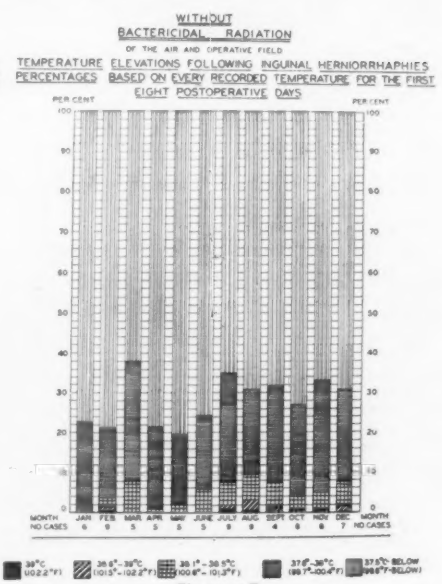

Chart 10B

CHART 10.—Every recorded temperature for eight days following inguinal herniorrhaphies. (A) With bactericidal radiation. (B) Without bactericidal radiation.

The percentages are based on every recorded temperature for eight days following operation. See legend to Chart 9 for note as to how the chart was prepared and the reason therefor. This chart has the same relationship to Charts 4 and 7 that Chart 9 has to Charts 3 and 6. See legends to Charts 4 and 7, and the legend to Chart 3 for five points for special consideration.

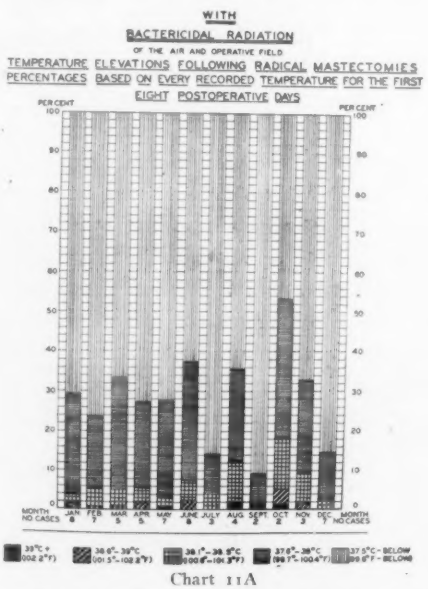

Chart 11A

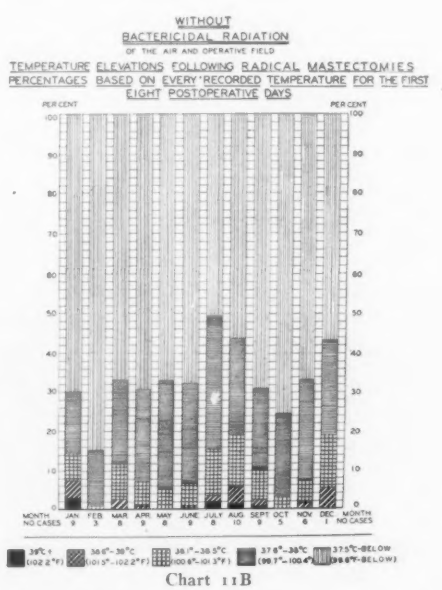

Chart 11B

CHART 11.—Every recorded temperature for eight days following radical mastectomies. (A) With bactericidal radiation. (B) Without bactericidal radiation.

The percentages are based on every recorded temperature for eight days following operation. See legend to Chart 9 for note as to how the chart was prepared and the reason therefor. This chart has the same relationship to Charts 5 and 8 that Chart 9 has to Charts 3 and 6. See legends to Charts 5 and 8 and the legend to Chart 3 for five points for special consideration.

days, since most temperatures are down to normal in less than that time. To cover a longer period would increase the minimum the percentage of the higher temperature groups. Attention is called to the same points of special interest as given in the legends for Charts 3 and 6.

the air contamination is lowest. When the air is sterilized we have the highest and most prolonged temperature reactions during the warmer months. It can also be noted that where radiation was not used (B in Charts 3 through 11) the drop in the average duration of elevated temperature and average height of elevation was not as great as the drop in the amount of air contamination (compare A and B Charts 3 through 11 and correlate with Charts 1 and 2).

COMMENT.—It seems to me that we have two conditions which vary with the time of year and that each has its effect on the postoperative temperature reaction. One of these is air contamination, which is quite variable with peaks and depressions throughout the year but in general is higher during the winter, may drop during April or May and begin to rise again from July to September or October (Charts 1 and 2). This contamination can, to a large extent, be overcome by sterilization of the air, and the results of this sterilization are seen by comparing A with B in the charts. The other condition is the temperature and humidity of the outside air, which may affect the patient directly by its influence on the dissipation of body heat or more indirectly by increasing perspiration, which facilitates the passage of bacteria out of the deeper layers of the skin, either directly by flow or indirectly by massage and maceration of the wet skin during the operative procedure. This contamination of the skin surface impairs our sterile technic and predisposes to wound contamination. In our section of the country, the general temperature and humidity of the air, with its resultant effect on the individual causing an increase in perspiration, reaches its peak during July and August, but may be of some significance from May through September. During April, May and June, the air contamination is usually low while the temperature and humidity are such that excessive perspiration is rare. Our best postoperative results without air sterilization occur during this period. During July and August, the air contamination is usually low but excessive perspiration is at its peak for the year. From April or May through July or August, we are less likely to obtain remarkable reductions in the postoperative temperature reactions by sterilization of the air, while during July and August, contaminated perspiration may cause an increase in the intensity of this reaction either with or without sterilization of the air. During September and October, with the cessation of excessive perspiration, there may be varying degrees of increase in the air contamination. In so far as this increasing air contamination causes an increase in the postoperative temperature reaction, we can obtain improvement by sterilization of the air. These general surgical principles, however, will in general be relatively stable with any operator working in the same operating room with a constant personnel. Local and general resistance of the patient may play an important part in the reaction in the wound and may vary widely with different individuals and with operations in different parts of the body. Particularly in the case of mastectomies, the local resistance may vary greatly as the result of variation in the amount of fat present and the blood supply available to all parts of the flaps. In certain cases without primary infection

sloughs develop in the skin flaps. Secondary infection is then inevitable and may cause slight but prolonged elevation of temperature. Three of the patients in the group of mastectomies with radiation had ulcerated lesions before operation, and following operation their wounds became mildly infected. Even though the ulcerated area was entirely covered during the operation, these patients ran a definitely increased risk of infection as a result of cutting across the lymphatics which drained the ulcerated area. These three infections accounted for three of the peaks of temperature elevation and duration where radiation was used (Charts 5 A, 8 A and 11 A—February, March and October). Children having a general anesthetic are more likely than adults to run a relatively high postoperative temperature elevation. This accounted for two of the higher temperature levels in herniorrhaphies performed with radiation (Charts 4 A, 7 A and 10 A—June and July).

SUMMARY.—(1) In the well-run, modern operating room air contamination by pathogenic bacteria is the greatest source of danger of wound contamination as indicated not only by gross suppuration in the occasional case but by an increased local and systemic reaction in many patients whose wounds never show evidence of gross suppuration. Over 95 per cent of this danger of contamination from the air can be eliminated by sterilization of the air with bactericidal radiation.[1, 2, 3, 4]

(2) In the occupied operation room this air contamination is, in general, much lower during the warmer than during the cooler months.

(3) Without air sterilization the decrease in the postoperative reaction of the patient during the summer is not as great as the reduction in the air contamination with pathogenic bacteria.

(4) With the elimination of air contamination by sterilization, the postoperative reaction of the patient is greater during the warmer months than during the colder months.

(5) Three and four in the summary can be explained by the rôle which perspiration may play in producing wound contamination by washing bacteria out of the deeper layers of the skin during the operative procedure.

CONCLUSIONS

Before the introduction of antiseptic and aseptic surgery, contact contamination of operative wounds played by far the major rôle in operating room infections, so that despite the emphasis placed by Lister on the air as a source of danger it came to be ignored.

With the great reduction in contact contamination brought about by the development of aseptic surgery and the improved local resistance of the patient brought about by improved hemostasis and the development of relatively atraumatic surgery, operations of progressively increasing magnitude were performed. With the elimination of most of the contact transfers of large numbers of bacteria in operative procedures, the fewer bacteria floating in the air have assumed the place of major importance to-day. This same

method of transfer probably plays an important rôle in the spread of certain infectious diseases, particularly those affecting the respiratory passages.[6, 7] In the small incisions made in individuals in vigorous health with minimal trauma, good hemostasis, nonirritating sutures and ligatures, and located in healthy tissue where dead space can be obliterated and the part kept at rest during the early stages of healing, the few mildly pathogenic organisms entering from the air will very rarely cause suppuration. As we diverge from these more or less ideal conditions and operate upon the patient who has less general resistance, carrying our larger procedures in which a greater amount of trauma is inevitable, in which complete hemostasis is difficult to obtain, at times in tissues of lowered resistance, possibly with dead space which cannot be obliterated or parts which cannot be immobilized or with the use of catgut which may at times be indicated, occasionally with the necessity of inserting drains, and during epidemics of respiratory infections when not only may the number of bacteria but the pathogenicity of the bacteria in the air be increased, the dangers of the wound's becoming infected with organisms dropping out of the air becomes progressively greater. Under any given conditions the local and systemic reaction of the patient is greater when more virulent organisms in larger numbers enter the wound.

With the elimination of the air as a source of wound contamination, perspiration assumes a position of major importance. By continuously washing bacteria out of the protected deeper layers of the skin it prevents the maintenance of sterility on the surface of the skin of the patient which may at times be exposed in the operative field, contaminates the sterile gowns of the team, and accumulates, in quantity, in the rubber gloves from which it may be expressed into the wound if an accidental puncture occurs. Perspiration may thus help account for the fact that in the summer months there is a greater postoperative temperature reaction than would be expected with the low air contamination. Likewise, the results obtained by sterilization of the air are not as striking during the warmer months as they are during the cooler part of the year when the air contamination is greater.

Air conditioning with the elimination of perspiration may bring us another step nearer that probably unattainable ideal of operating without the entrance of any bacteria into the wound.

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[6] Wells, W. F., and Wells, M. W.: Air-Borne Infections. J.A.M.A., **107**, 1699, 1936.

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DISCUSSION.—DR. REGINALD H. JACKSON (Madison, Wis.): History, I am sure, will record an ever increasing debt of gratitude to Hart and his colleagues for their pioneer work in calling attention to the hitherto generally overlooked fact that entirely aside from the long-recognized sources of clinical wound infection, such as imperfect sterilization of instruments, ligatures, gloves, *etc.*, there exists a most potent direct source of wound contamination and infection in the air of the operating room, one which strikes with a frequency and viciousness in direct relation to: First, the number of human beings in the room and; second, the time of the year, the peak of clinical wound infections synchronizing with the peak of upper respiratory infections of humans.

All surgeons, without exception, must be aroused to a renewed interest in this subject. Through the scientific investigations of Hart, Ives, and Hirschfield, J. Staige Davis and others, the following statements may be accepted as unequivocally true:

(1) That practically all operating rooms contain, in the air, on the floors, walls and ceilings, more Staphylococci and, at times, hemolytic Streptococci, than any other department in the hospital except the nose and throat department.

(2) The *Staphylococcus aureus* is the principal and general source of infection of clinical wounds.

(3) These infecting agents gain direct entrance to the wound by precipitation from the air overlying the wounds, and by droplet infection.

(4) Every wound made by the surgeon is contaminated and potentially infected in direct proportion to its size and the length of time of its exposure.

(5) There are nearly always in the room, carriers of *Staphylococcus aureus* or hemolytic Streptococcus.

(6) The surgeon himself may unwittingly be a carrier.

(7) A run of such cases always means that the air of the room contains (as proved by culture) a higher percentage of these organisms than normally.

(8) While the average incidence of such baleful clinical wound infections is from 4 to 6 per cent (heretofore recognized as an irreducible minimum), it at times rises to 18 to 20 per cent.

(9) A scientific bacteriologic check-up on every link in the so-called aseptic chain may achieve a 100 per cent credit, and yet the incidence of clinical wound infections continues at two to three times the average.

Certainly we all know that it is within the power of the surgeon to change a contaminated, potentially infected traumatic wound into a clean one which will generally heal per primam, through débridement and thorough cleansing with soap. Why—in view of the fact that nearly every wound made by the surgeon may be proved to be contaminated with Staphylococci from the air—should we not apply the same "debacterializing" method? Objections on the basis that it would be a messy, unsurgical and unnecessary procedure that would violate the great surgical principle of keeping the wound as dry as possible, and would militate against ideal wound repair, are annihilated by actual trial of the method in over 200 instances, proving that instead of militating against primary union, it actually insures ideal wound repair and lowers the incidence of clinical wound infection practically to the vanishing point.

There will always be instances of secondary wound infection, as uncontrollable factors are involved entirely aside from the presence of bacteria in the wound. Whether the "debacterialization" of a clinical wound is accomplished before closure by this method or by the Hart method is immaterial; I am convinced that surgeons should and will use one or the other until something better offers. We have been hypnotized too long by the phrase "the aseptic chain technic," overlooking the factor of direct air contamination which Hart and others are again calling to our attention. Any surgeon who doubts the verity of these contentions may, and should, repeat the tests under the supervision of a bacteriologist and forever be disabused of the idea that it is all nonsense.

Dr. Waltman Walters (Rochester, Minn.): It seems to me that this epochal study, clinically as well as experimentally, deserves more consideration by this Society as well as by other surgical societies than has resulted to date. It carries a great deal of economic as well as medico-legal significance. I would like to see this topic chosen for presentation at a symposium at the next meeting of this Society. To change the set-up in operating rooms throughout the country will entail considerable expense, which must be borne by the patient in the long run. It will be interesting to note the results which other surgeons obtain in closed, irradiated operating rooms.

At the Mayo Clinic, we are able to obtain consent for postmortem examination in approximately 90 per cent of cases. For 14 years, I have studied the causes of death after operations on the biliary tract and stomach, and the outstanding thing has been the infrequency with which infection of wounds or intraperitoneal infection has played a part, unless there was an associated toxemia or debility or unless a severely infected lesion was being operated upon. In the cases which I studied, the failure to recover after surgical procedures was caused principally by pulmonary complications such as infection, infarcts or embolism.

Doctor Hart stated that, in the late summer months, when perspiration is more active than at other times, the incidence of infections increases. Might that not be a matter of lowered resistance of the patients after passing through extremely hot weather, in which we know the physiologic resistance of the patient as well as of the doctor is reduced, rather than an increase in the frequency or virulence of the infection? Doctor Hart has stated, I believe, that the temperature and pulse rate indicate the degree of infection. Might it not be that infections in other parts of the body, in the respiratory tract and urinary tract particularly, which frequently occur immediately after operation, are partly responsible for fever or increase of pulse rate?

There is another factor in the study which I think deserves consideration. What is the effect of such irradiation in a closed operating room over long periods each day on the people who work in that room, such as the nurses, interns, anesthetists and the surgeons? We are studying the effect of a strong light used in the operating field, on fatigue of the eyes of the surgeon and assistants. There are many possibilities for studying the effects of the performance of surgical procedures on the surgical team itself, such as the effects on the surgeon's blood pressure after two or three operations have been carried out, the fatigue of the eyes, muscles and nerves, and so forth. Has Doctor Hart studied these questions in relation to irradiation of the operating room as far as the personnel of the operating room is concerned? That, it seems to me, should be an important part of the study. If this method of sterilization of the surgical field plays a rôle in the reduction of incidence of infection, we must be prepared to withstand criticism for failure to use it,

if infections of wounds should develop. I hope that there will be some surgeons who also will study this problem from the points of view of the set-up of operating rooms in general use to-day.

DR. ISADORE COHN (New Orleans, La.): There are two or three thoughts which have occurred to me, and I believe many of them could be answered very definitely almost by a rising vote. Do the members of this Society have, generally, so large a percentage of wound infections, not under irradiated conditions? The men who are operating in smaller towns have to consider the expense of introducing this apparatus. I believe further, that if we sincerely feel this is an essential thing, is it not our duty when we get home to insist that hospitals do this? Are we going to revert to the time of Lister and his carbolic spray?

I think Doctor Walters' suggestion of a symposium is an excellent thing. I wonder if there is not some possibility of a lawyer taking a case for somebody with a burn which they might say might be accounted for by irradiation.

DR. FRANK STRICKLER (Louisville, Ky.): As I see it, this question simmers down to two propositions. We can sterilize the operating room, the dressings, the instruments, but we still have the patient to consider. We all know that we have foci of infection in the gallbladder, teeth, tonsils, intestinal tract, *etc.* The problem is, if we sterilize all these other agencies, how are we going to sterilize the patient? If we make a wound and he has a lot of bacteria circulating in the blood stream, he is likely to develop infection, and I do not believe we can ever overcome that. Up in Kentucky we do not have so many infections. Once or twice I have inadvertently punctured a glove, and the patient got well without infection. I do not understand why we get so many infections in certain parts of the country. Maybe we are careless and do not watch things so well, but the patients heal up all right. There are many angles to be considered.

DR. DERYL HART (Durham, N. C., in closing): I agree with what Doctor Jackson has said, and I think that washing out the wound is a valuable procedure. We have followed this technic for many years and find that it washes out much débris, particularly loose particles of fat, coagulated serum, and blood. Before beginning sterilization of the air we washed out all large wounds very thoroughly, but were disappointed in that we could not eliminate the occasional infections by such a technic. I want to emphasize again that I think it would be a great detriment to surgery if, for any reason, we should give up any of the generally accepted practices of good surgery such as sterility, avoidance of trauma, meticulous hemostasis, obliteration of dead space, avoidance of irritating sutures or drains where possible, immobilization of the wound, *etc.* Sterilization of the air attacks only one source of infection—the air—highly contaminated probably because of the inadequacy of our operating room masks. Organisms on the skin, or if by chance in the blood stream, or those introduced by contact contamination, may not be affected by air sterilization, so we must maintain our best surgical technic, and cannot assume that the wound is free of bacteria even if the air is completely sterilized.

Again may we emphasize that our principal objective has been to prove the importance of the air as a source of wound contamination. Bactericidal radiation was adopted as the only practical means of sterilizing the air in order to prove the importance of this source of contamination by its elimination. The results given in this paper, in our opinion, prove that the contamination in the air of our operating rooms is at the present time the greatest source of danger of wound infection in clean operations.

In reply to Doctor Walters, we can say that so long as the law requires that "a man have the skill and use the precautions such as are accepted by the profession in the community where he works" he will have no need to fear the lawyers. Until sterilization of the air is more universally accepted as part of the operating room technic, no lawyer will have a case even though it could be proved that the infection came from the air. For the patient or his lawyer to prove that any specific infection came from a definite source would be all but impossible. If the time comes when sterile air is generally accepted as a requirement of good operating room technic, the lawyer then may have a case. In the meantime, for the doctor who is convinced that most of his infections come from the air, his conscience may be more annoying than his patient's lawyer.

In reply to the question of expense making the use of bactericidal radiation prohibitive, these tubes now retail for $10.00 each, so the cost of equipping a room is probably less than the cost of a good operating room light. They consume only about 10 watts of current per tube and our tubes, that have been in use for over two years, show less than 10 per cent depreciation in output of bactericidal radiation.

In regard to the type of operations in which the air should be sterilized, we do not consider it imperative in small incisions. For arthroplasties, extrapleural thoracoplasties, radical mastectomies, large ventral herniae in obese patients, *etc.*, we feel it is indispensable. As time goes on, probably we will not be content with compromise in our sterile technic, regardless of the small size of the operation or the presence of other possible sources of contamination.

We do not believe that all the postoperative temperature elevation comes from the patient's reaction to bacteria in the wound, but after two and one-half years' experience in eliminating the bacteria from the air we are convinced that they play a major rôle in its production.

The question of eye fatigue has been raised. There would be no fatigue from the radiation itself, since the ray is invisible. However, it is necessary to protect the eyes by glasses or goggles and unless these are optically satisfactory they might cause symptoms. The radiation does not penetrate plain glass to any appreciable degree, but a high grade of pyrex glass may transmit a small percentage. We have made some blood studies on individuals working in a field of bactericidal radiation but have been unable to detect any change.

In regard to our "high percentage of infections" without bactericidal radiation, we feel that our rate of 4 per cent (exclusive of thoracoplasties) is about as low as we can expect.

Doctor Strickler made the statement that "we cannot sterilize the patient in one way and do not want to sterilize him in another." We make no claim that this radiation will kill the bacteria on the skin, since they might be protected in the crevices, and would never expect any effect on the bacteria within the body or its epithelial lined spaces. However, since this ray has very little penetrating power, we can at least feel assured that there is no danger of sterilizing the patient in any other way.

As already stated, I see no immediate or remote prospect of eliminating every source of wound contamination, such as from the skin or blood stream of the patient. This, however, should not deter us from eliminating a known source that in our opinion is of far greater importance.

BRIEF COMMUNICATIONS AND CASE REPORTS

AN ARTIFICIAL ANUS WITH MECHANICAL SPHINCTER

JOHANNES F. S. ESSER, M.D.

MONACO

THE operation to be described was designed to afford a method of voluntarily controlling the fecal discharge from a permanent colostomy.

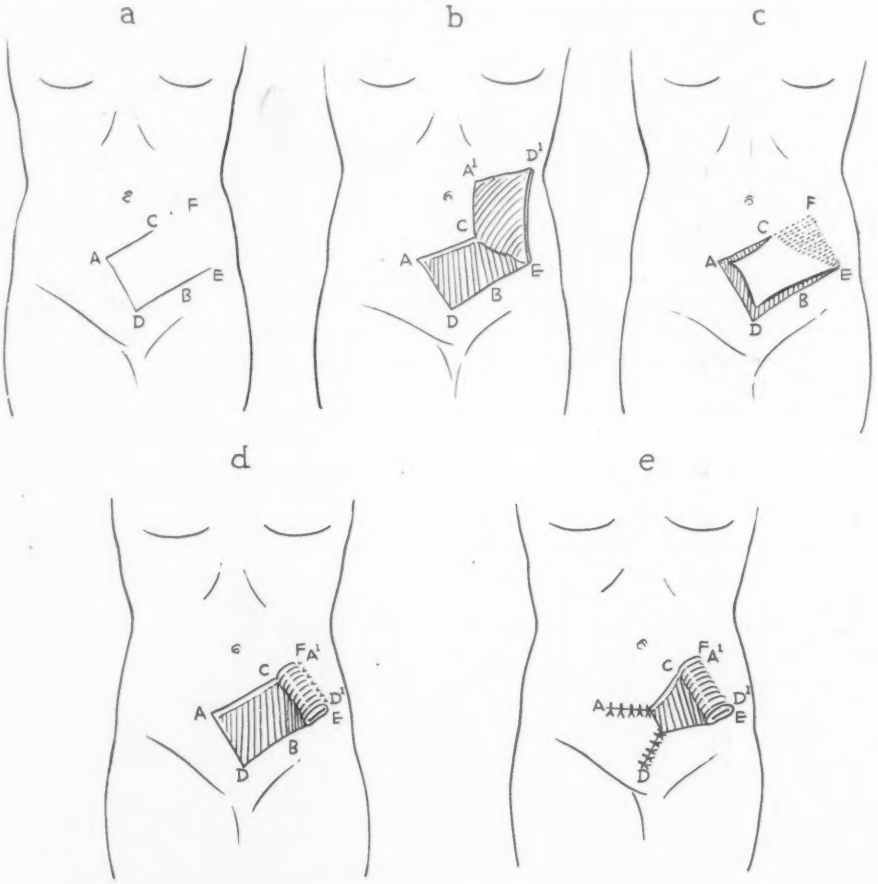

FIG. 1.—(a) Shows the outline of the incision employed (CADE). (b) Shows the skin flap reflected laterally. (c) Shows the freed skin flap ACDE, the skin of the part CFE being only loosened. (d) Shows the protruding, proximal end of the intestine wrapped in the skin flap. (e) Shows the edges of the denuded area approximated by longitudinal sutures.

Operative Technic.—A skin flap, CADE, is outlined and raised from the underlying tissues, the skin of the area CEF being merely separated from

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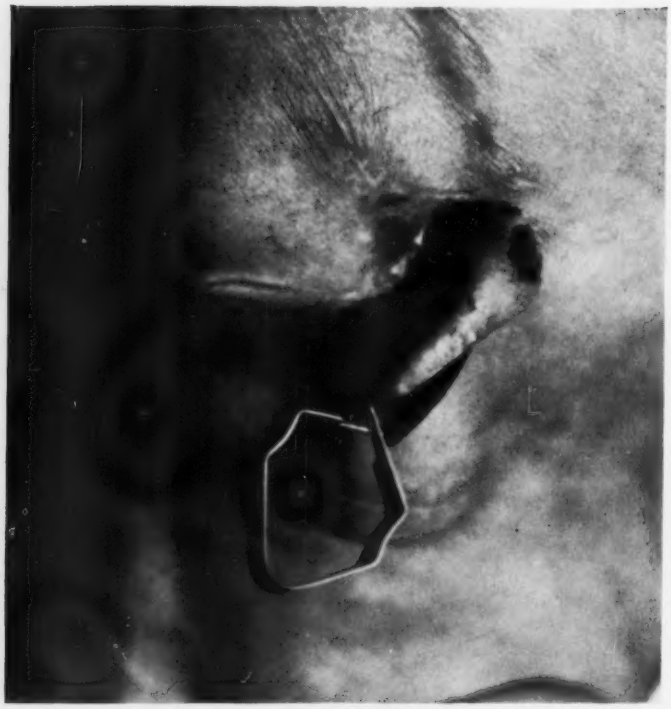

FIG. 2. (Case 1.)—Shows the application of a spring clamp to the base of the skin tube containing the intestine.

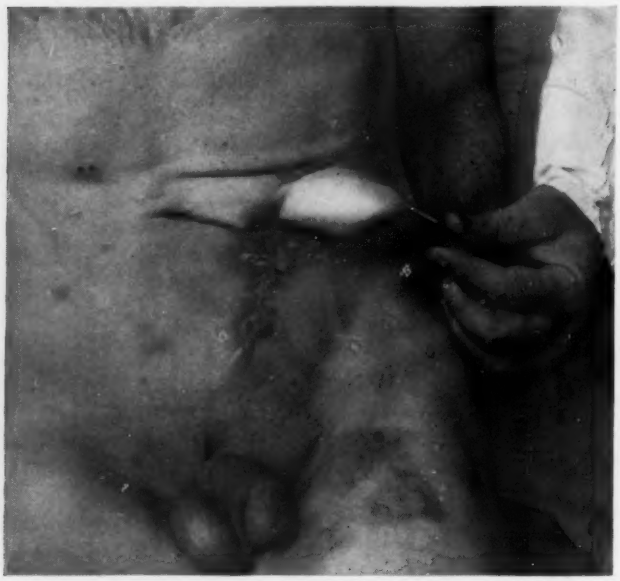

FIG. 3. (Case 2.)—Shows the final result. The irregularly scarred, triangular area is the site of the epithelial inlay graft. Pincers have been introduced into the orifice of the intestinal segment.

the underlying tissues. The flap is turned laterally on its pedicle CE.

The opening into the peritoneal cavity is made between points C and F underneath the skin flap while the flap is retracted upward to its utmost limit at points D′ and A′.

The loop of the colon which is to form the colostomy is withdrawn. The bowel is severed and the proximal segment, with its distal end temporarily clamped, is wrapped in the skin flap which is now directed downward.

The point D′ of the skin flap is sewn by means of a metal suture to point E. The colon emerges from this opening. Interrupted metal sutures are then employed to anchor the border A′D′ of the skin tube, containing the colon, to the line FE.

In order to partially obliterate the defect caused by raising the flap, traction is applied to the skin at the angle A by means of a simple hook, and the skin borders AC and AD are sutured as far as possible without causing excessive tension. In the same way traction is applied at the angle D and the skin borders DA and DE sutured. The area still denuded of skin is covered with an epithelial inlay (Esser). The inlay consists of a thin free skin graft placed upon a mold of stent-mass which has been fashioned to fit the defect accurately. The graft may be taken from the thigh or from the inner aspect of the arm. By applying firm pressure to the mold for seven days, the accumulation of secretion beneath the graft is prevented and healing is insured. The secondary defects are dressed with dry or vaselinized gauze.

The clamp is then removed from the cut end of the bowel and the circular margins of bowel and skin tube approximated by means of interrupted metal sutures.

The new anus remains open and functions directly after the operation, the surrounding skin and sutures being protected by zinc ointment. The epithelial inlay pressing on the wound prevents fecal contamination.

Adequate nourishment of the extraperitoneal intestinal segment is insured by the vascular anastomoses which occur between the subcutaneous vessels of the skin tube and the vessels of the serosa of the bowel, as well as by the vessels severed at the cut end of the bowel. Because of the rich circulation of the skin tube, derived from its wide pedicle, a spring metal clamp may be applied to the tube after one month without fear of embarrassing the circulation of the bowel.

AN ELECTROSURGICAL OPERATION FOR EXCISION OF AN HYDROCELE SAC

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ELECTROSURGERY has not to our knowledge been used as an aid in hydrocele operations, and for this reason it is the purpose of this paper to record briefly our experience with the Bovie electrosurgical unit in the treatment of hydrocele. Massive postoperative hematoma is a most serious complication that occasionally follows hydrocele operations. Especially is this most likely to occur in large hydroceles with thick-walled sacs. An active hemorrhage after operation may necessitate a second operation to remove the blood clot and stop the bleeding. The Andrews tunica vaginalis eversion operation—the so-called "bottle operation"—is more frequently followed by recurrence of the hydrocele than the Winkelman sac-excision operation; although postoperative hemorrhage is more frequent after the latter. An infected, large, postoperative hematoma causes the patient great distress, though it, fortunately, is an unusual complication.

We began to use electrosurgery with the idea of reducing the incidence of postoperative hemorrhage and hydrocele recurrence. In the present series of 12 cases, it proved to be a simple, safe and easy method of excision of the tunica vaginalis and was totally devoid of complications.

Technic of Procedure.—The left hand of the operator gently grasps the posterior surface of the scrotum, and the skin over the anterior surface of the hydrocele is stretched until it is taut. An anterior vertical incision, of necessary length, is made a few centimeters from the median raphe, with the cutting Bovie current, through the skin and all of the fascial and muscular layers down to, but not including the tunica vaginalis, if it can be avoided (Fig. 1). Occasionally, we opened the sac by our incision, although it was not particularly desired, because it is much easier to free an unopened sac from the surrounding tissues than one that has been evacuated. If the sac has not been opened, it is gently stripped from its covering layers, and its contents are aspirated with a trocar. The sac is then opened and excised, with the cutting Bovie current, to within 1 or 1.5 cm. of its attachment to the visceral layer of the tunica vaginalis (Fig. 2). Bleeding points are caught with mosquito clamps, and all oozing is controlled with the coagulating current. The skin and fascial layers are included in the interrupted, vertical mattress sutures of silk, that close the wound. Dry sterile dressings are applied and the scrotum is supported by means of an adhesive plaster bridge.

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ILLUSTRATIVE CASE REPORTS

Case 1.—Male, age 25, gave a history of trauma to the scrotum, several months before admission to the hospital. Five days before admission, 800 cc. of light amber-colored fluid was aspirated. On admission a globular mass, 7 x 12 cm., was present in

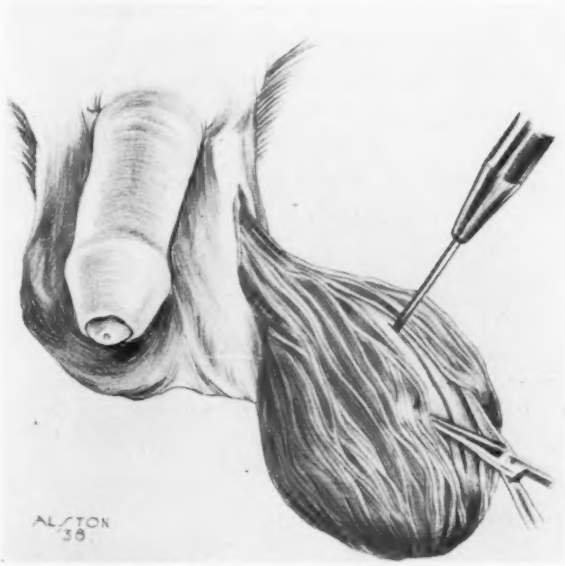

FIG. 1.—Shows the electrode in place. Scissors separating the hypertrophied fibers of the cremasteric muscle and infundibuliform fascia from the tunica vaginalis. Marked hypertrophy of the cremasteric muscles is a common finding in large hydroceles of long standing, although rarely mentioned. In this drawing it is too prominent.

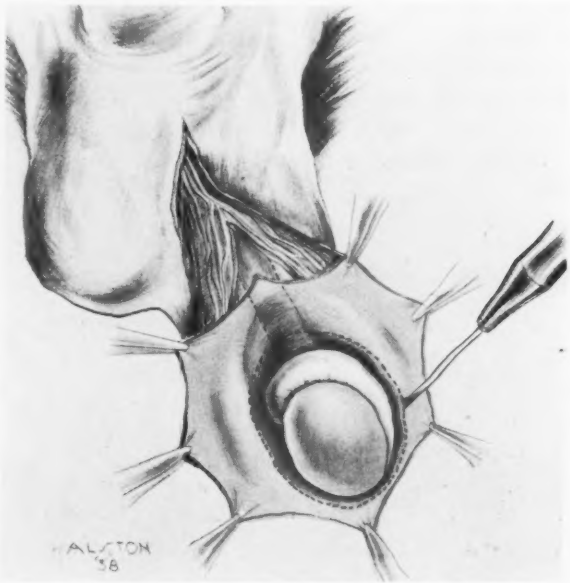

FIG. 2.—Shows the tunica vaginalis opened and the line of sac excision.

the left side of the scrotum. It was not tender and trans-illuminated. The sac was excised, under spinal anesthesia, and the wound sutured without drainage. He was discharged eight days after the operation as cured.

Case 2.—Male, age 34, complained of a left-sided scrotal mass that had been present for "some time." Examination showed a nonpainful cystic mass, 10 x 12 cm., which transilluminated. The operative wound healed by primary intention.

Case 3.—Male, age 68, states that he has had a mass in the right side of his scrotum for years. Examination showed a large, nonpainful cystic mass in the right side of the scrotum, 10 x 12 cm., which transilluminated. The hydrocele sac was excised under local anesthesia. The wound healed by primary intention, except for a small slough at its lower angle.

Case 4.—Male, age 38, who had noted a mass in the right side of his scrotum for some months. On examination, it was not tender, 5 x 6 cm. Under spinal anesthesia, the sac was excised and the wound healed per primam, except for a very slight skin slough at its lower angle.

The advantages of this method are: (1) Excellent hemostasis; (2) skin crypt sterilization is accomplished; (3) no absorbable suture material is left buried in the wound; (4) drainage is unnecessary. Its disadvantages are: (1) Cannot be employed in the presence of ether or other inflammable general anesthetic agents; (2) slight tendency for aseptic skin slough at lower angle of wound.

CONCLUSION

The use of electrosurgery as an aid in the operative treatment of hydrocele is apparently of value and is worthy of further trial.

UNILATERAL AGENESIS OF THE MÜLLERIAN SYSTEM IN THE FEMALE

CASE REPORT

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Embryologic Considerations.—The müllerian ducts first appear in the embryo during the sixth week of development, at the anterior ends of the wolffian ridges, on their ventrolateral aspects. The solid process of cells forming each müllerian duct reaches the cloaca after a week's growth, and subsequently develops a lumen. In the male fetus, atrophy of the müllerian ducts begins in the third month, but in the female development continues. The cephalic portions of the müllerian ducts form the uterine tubes, while the caudal portions fuse, giving rise to the uterus and, later, to the vagina. The fused medial walls of the two ducts degenerate, thereby creating a single-barrel uterus and vagina. The ligamentum teres (the homologue of the gubernaculum testis in the male) arises as a condensation of mesenchyme in the inguinal fold of

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peritoneum; although attached to the müllerian duct, its origin is independent of that structure.

The type of malformation of the uterus, the vagina and the tubes depends on the embryonic age at which the development of the müllerian system deviates from the normal or becomes arrested. During the first month there may be unilateral or bilateral failure of development. During the second month, the two sides may fail to fuse, with the result that a double uterus and vagina are

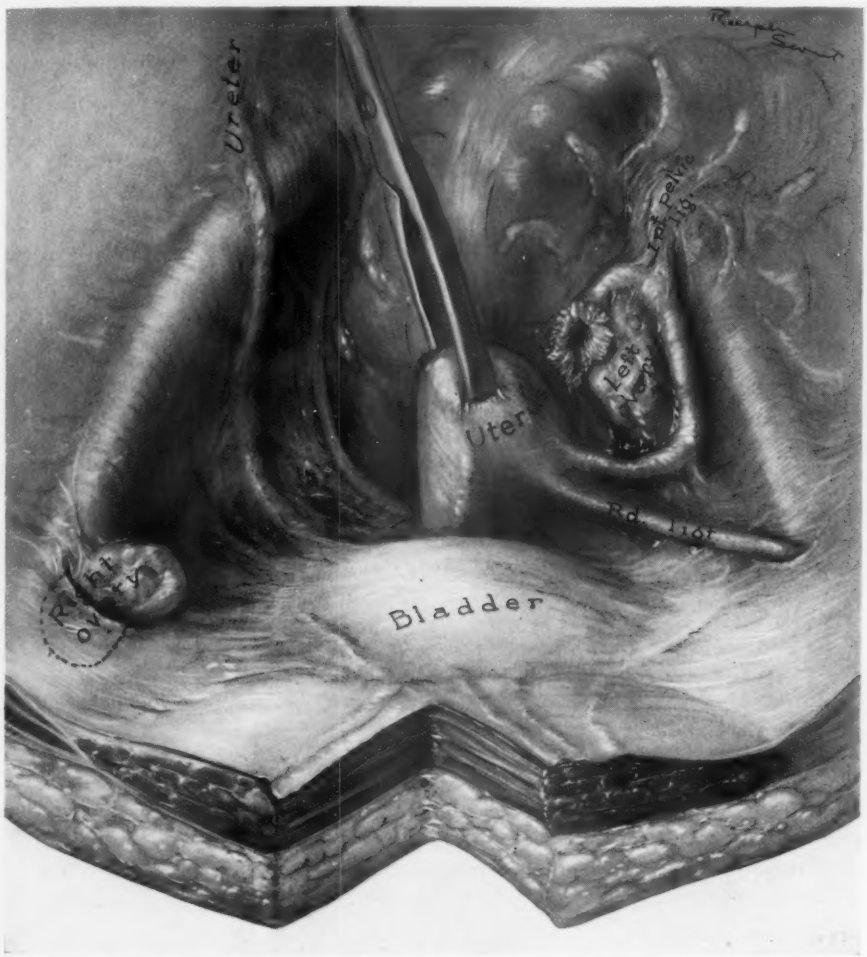

FIG. 1.—View of the pelvic viscera. Note the congenital emptiness of the right side of the pelvis.

formed (uterus didelphys); or the arrested development may be unilateral, resulting in a rudimentary horn on one side. In the third and fourth months there may be incomplete fusion of the two müllerian ducts, giving rise to a uterus with two distinct horns (uterus bicornis), or a uterus with a concave fundus (arcuate uterus); in either form the septum may or may not persist and the cervix may be single or double. After the fifth month, the only anomaly is an arcuate uterus. In addition to the anomalies mentioned above, there may

be persistence of the septum in a uterus which appears externally normal. This septum may or may not extend into the vagina (uterus septus duplex or uterus et vagina septus duplex).

The type of anomaly presented in the appended case report is exceedingly rare. The only reference to it found in the literature is in Fritz Kermauner's chapter on the malformations of the female genital apparatus in Halban's System of Gynecology. He states that although there are infrequent case reports of hemiuterus, on close scrutiny they turn out to be uteri with a rudimentary horn. In an exhaustive survey of the literature of the preceding 100 years, Kermauner quotes only three instances where he was reasonably certain that there was a complete unilateral agenesis of the müllerian duct.

Case Report.—The patient was an unmarried, white female, age 32, who complained of periodic attacks of pain in the right lower quadrant of the abdomen. They had first appeared in May, 1935, slowly increased in severity and had become intense four weeks before her first visit, in May, 1937. There had been a loss of five pounds in weight. The pain was cramp-like in character, and occasionally was accompanied by nausea, but never by vomiting; it was most pronounced during the four days preceding each menstrual period and was aggravated by putting the abdominal wall under tension. It was not affected by diet, meals or stools; relief was obtained by lying down with the thighs flexed.

Her menses had always been regular, every 28 days, lasting from three to six days, with a moderate flow; prior to the onset of the present illness they had not been accompanied by pain. There was no history of any specific infection and her past history was entirely negative.

Physical Examination was not remarkable except for the abdominal and the pelvic findings. There was deep tenderness at McBurney's point. The vagina admitted two fingers. The cervix was pointing to the right and there was a slightly tender mass, vague in outline, in the left fornix.

Operation.—Upon opening the abdomen it was noted that the uterus was small and tilted to the left, with the right and superior surfaces meeting at right angles; it was obviously a left hemiuterus. The left broad ligament with its contents was normal in appearance. On the right, the broad ligament, the tube, and the abdominal portion of the round ligament were completely absent, leaving the right half of the pelvic cavity empty. The right ovary, normal in size and appearance, was situated at the internal inguinal ring, partly drawn into the inguinal canal by the ligamentum teres to which it was attached (Fig. 1).

The ovary was disengaged from the inguinal ring and, to prevent the recurrence of herniation, the round ligament was sutured to the deep aspect of the aponeurosis of the external oblique muscle, as in a modified Gilliam suspension of the uterus.

The patient had an uneventful convalescence. She has been completely relieved of her symptoms and has regained her normal weight.

ANNOUNCEMENT OF THIRD INTERNATIONAL CANCER CONGRESS

THE THIRD INTERNATIONAL CANCER CONGRESS under the auspices of the International Union Against Cancer, whose headquarters are in Paris, will be held at the Chalfonte-Haddon Hall, Atlantic City, New Jersey, September 11–16, 1939.

The President of the Congress is Dr. Francis Carter Wood, Director of the Institute of Cancer Research of Columbia University. The executive officers are physicians well known for their experience in these matters: Dr. Donald S. Childs, of Syracuse, is Secretary-Treasurer; Dr. Eldwin R. Witwer, of Detroit, is in charge of the scientific exhibits; and Dr. A. L. Loomis Bell, of Brooklyn, is handling the commercial exhibits and transportation.

The Congress has been divided into Groups under Section Chairmen, of whom Dr. John D. Camp, of the Mayo Clinic, will handle Diagnostic Roentgenology; Dr. Ursus V. Portmann, of the Cleveland Clinic, Radiotherapy; Dr. Frank H. Lahey, of the Lahey Clinic, Boston, Surgery; and Dr. C. C. Little, of the Jackson Memorial Laboratory, Bar Harbor, Maine, Genetics. The program on Experimental Pathology has been organized by Dr. William H. Woglom, of the Institute of Cancer Research of Columbia University; General Pathology is under that able teacher, Dr. Milton C. Winternitz, of Yale University; Radiobiology and Radiophysics have for Chairman Dr. G. Failla, of the Memorial Hospital, New York; and Dr. Burton T. Simpson, of the State Institute for the Study of Malignant Disease, Buffalo, is Chairman of the Section on Statistics and Education. Numerous assistant chairmen have been appointed.

A number of sections will include elaborate symposia on special topics. For example, there will be a combination meeting to discuss the treatment of the lymph nodes of the neck after the destruction of the primary neoplasm. A number of similar combination meetings will be held.

A rather unusual feature of the Congress is that the evenings will be devoted to addresses by well-known experts. For instance, on Monday evening, Dr. A. Lacassagne, of the Radium Institute of Paris, will give a survey of the relation of estrogens to malignancy; and Dr. C. C. Little, of Bar Harbor, Maine, will summarize our knowledge concerning genetics and tumors. On Tuesday evening, Drs. J. W. Cook and E. L. Kennaway, of London, will discuss the "Chemical Compounds as Carcinogenic Agents," and Dr. W. E. Gye, also of London, will report on the viruses. On Wednesday evening, it is expected that Senateur Justin Godart, former Minister of Health in France and President of the International Union Against Cancer, will make a short address, followed by Surgeon General Thomas Parran, of the United States Public Health Service, who will discuss phases of the Government activity in the investigation and treatment of cancer. Thursday

evening will be devoted to talks on the developments in surgery by Dr. Frank H. Lahey, of Boston, and the organization of a Cancer Clinic by Professor Fred J. Hodges, of Ann Arbor, Michigan. Friday evening, the Congress will be closed by an address from Dr. S. Bayne-Jones, Dean of the Yale University School of Medicine, and by Professor James Ewing, of the Memorial Hospital, New York, who will summarize what has been accomplished and what should be done for the cancer problem in the future.

Extensive commercial and scientific exhibits have been arranged. Projection apparatus of all types will be available, and judging from the number of papers already received the Congress will be an outstanding one. Official delegates will be present from various foreign countries, including England, France, Belgium, Germany, Switzerland, Poland, Hungary, Italy, Russia, Chile, Argentina and other countries in South America.

BOOKS RECEIVED

THE receipt of books for review is hereby acknowledged. This statement shall be regarded as sufficient acknowledgment of the courtesy of the publishers. Selections will be made for review predicated upon the interests of the readers of the ANNALS OF SURGERY and as space permits.

MODERN SURGICAL TECHNIC. By Max Thorek, M.D. Philadelphia: J. B. Lippincott Co., 1938.

SURGICAL TECHNIQUE AND PRINCIPLES OF OPERATIVE SURGERY. By A. V. Partipilo, M.D. 3rd Ed. Chicago: The John Maher Co., 1938.

SPINAL ANESTHESIA. By Louis H. Maxson, M.D. Philadelphia: J. B. Lippincott Co., 1938.

HANDBOOK ON CANCER. By Cancer Control Commission, Canadian Medical Association, Toronto, Canada: Murray Co., Ltd., 1938.

THE 1938 YEAR BOOK ON GENERAL SURGERY, Edited by Evarts A. Graham, M.D. GENERAL MEDICINE, Edited by George F. Dick, M.D., J. Burns Amberson, Jr., M.D., George R. Minot, M.D., S.D., F.R.C.P. (Hon.) Edin., William B. Castle, M.D., M.D. (Hon.) Uttrecht., William B. Stroud, M.D., and George B. Eusterman, M.D. EYE, EAR, NOSE AND THROAT, Edited by E. V. L. Brown, M.D., Louis Bothman, M.D., Samuel J. Crowe, M.D., and Elmer W. Hagens, M.D. The Year Book Publishers, Inc., Chicago, 1938.

TEXTBOOK OF NEURO-ANATOMY AND THE SENSE ORGANS. By O. Larsell, Ph.D., New York and London: D. Appleton-Century Co., Inc., 1939.

ANATOMY OF THE HUMAN LYMPHATIC SYSTEM. By H. Rouvière, Professor of Anatomy at the Medical Faculty of Paris, France. Translated by M. J. Tobias, M.D. Edwards Bros., Inc., Ann Arbor, Michigan, 1938.

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Original typed manuscripts and illustrations submitted to this Journal should be forwarded prepaid, at the author's risk, to the Chairman of the Editorial Board of the ANNALS OF SURGERY

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